MONOGRAPH OF THE NORTH AMERICAN SPECIES OF THE GENUS EPHEDRA[1]

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INTRODUCTION

The importance of the drug, ephedrine, secured from Asiatic species of *Ephedra,* in the treatment of nasal colds, asthma and hay fever has attracted wide attention to this genus. Workers in range management have investigated the relative palatability of various species, and students of phylogeny have speculated on the role of the genus in a phylogenetic sequence. These last have contributed to the confusion in the terminology for, in addition to applying descriptive terms derived from Angiosperm and Gymnosperm sources, they coined new ones. Unfortunately, many of the investigations are of little value because the material was incorrectly identified or was a mixture of more than one species.

Correct determination of material is extremely difficult, for the number of species has nearly doubled since the publication of the last monograph of the entire genus and many of them were originally described from sterile or from staminate material. Approximately two-thirds of collected specimens cannot be identified with certainty from existing descriptions. The present study determines the correct application of names, proposes several new ones for hitherto undescribed forms, delimits the North American species, and provides means for their accurate determination. The South American species are not discussed in the present work but will be taken up later.

Manuals, floras, and other works which recognize species of

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Ephedra are not cited in the text of this paper unless they are necessary for bibliographical reasons. Such citations might indicate acceptance of the entities as delimited in those works, which is usually not the case. The more important publications may be found in the history, generic and specific synonymy, and bibliography.

HISTORY

Ephedra has been known and used medicinally in China for about five centuries. Its general acceptance by Western pharmacists is comparatively recent. Groff and Clark[2] summarize the history of its use in medicine and indicate the scant value many analyses have because the material upon which they are based is not definitely determined. To be serviceable, analyses of the plants should be accompanied by the name of the species and the location of herbarium material, the locality in which it grew, the date of collection, the parts of the plant analyzed, and the methods of drying, of extraction and of measurement.

The genus *Ephedra* was definitely established by Linnaeus in the 'Species Plantarum'[3] and in the 'Genera Plantarum'[4] of 1753 and 1754 respectively. Two species, *E. distachya* and *E. monostachya,* were included by him in the former publication. The first North American species to be described was *E. antisyphilitica* in C. A. Meyer's[5] monograph of the entire genus. In 1848 Torrey[6] recorded another species as *"Ephedra occidentalis"* which was later validly published by Watson[7] as *E. trifurca.* Watson[8] described three species, *E. californica, E. nevadensis,* and *E. Torreyana,* in 1879; and four years later[9] published *E. aspera* and *E. pedunculata* from the notes of Engelmann. The second and latest monograph of the genus appeared in 1889, and in it Stapf[10] published two subvarieties of *E. nevadensis,* subvar. *paucibracteata* which is synonymous with the species, and subvar. *pluribracteata* which is a synonym of *E. viridis* Coville[11] published in 1893. In 1909 the most southern of the North American species, *E. compacta,* was described by Rose.[12] Johnston[13] in 1922, and Cory[14] in 1938, described *E. peninsularis* and *E. Reedii* respectively, both of which are synonyms for *E. aspera.* Groff and Clark[15] published a survey of the North American species in 1928 as an aid to the study of the drugs contained in plants of the genus. Nelson[16] described *E. fasciculata* from vegetative material in 1935, and in the same year Coville and Morton[17] proposed *E. funerea,* and Reed[18] *E. texana,* which is synonymous with *E. antisyphilitica. E. Coryi* Reed[19] was published in 1936, and in 1938 *E. Reedii* Cory and *E. antisyphilitica* var. *brachycarpa* Cory[20] appeared.

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[2] Groff & Clark in Univ. Calif. Pub. Bot. **14**: 247–282, *charts 1–6.* 1928.

[3] L., Sp. Pl. **2**: 1040. 1753.

[4] L., Gen. Pl., ed. 5, 462. 1754.

[5] Meyer, C. A. in Mém. Acad. Imp. Sci. St. Petersburg. VI, Sci. Nat. **5**: 291. 1846.

[6] Torr. in Emory, Mil. Reconn. 151. 1848.

[7] Wats. in U. S. Geol. Surv. Fortieth Parallel [Bot. King's Exp.] **5**: 329. 1871.

[8] Wats. in Proc. Am. Acad. **14**: 299. 1879.

[9] Wats. in Proc. Am. Acad. **18**: 157. 1883.

GENERAL MORPHOLOGY

The North American members of the genus are, with the exception of the clambering *E. pedunculata,* erect woody shrubs. All species have reduced scale-like leaves and photosynthetic young stems.

Seedlings.—The tap-root of the young seedlings soon branches to form a fibrous root system with numerous root hairs and a diarch or occasionally triarch stele. Two cotyledons are produced. The first leaves of all species are borne in pairs, and the ternately leaved forms show the whorled arrangement only after several pairs have been produced. In *E.*

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[10] Stapf in Denkschr. K. Akad. Wiss. Wien **56^2**: 1–112, *pls. 1–6, 1 map.* 1889.

[11] Coville in Contrib. U. S. Nat. Herb. **4**: 220. 1893.

[12] Rose in Contrib. U. S. Nat. Herb. **12**: 261. 1909.

[13] Johnston in Univ. Calif. Pub. Bot. **7**: 437. 1922.

[14] Cory in Rhodora **40**: 216. 1938.

[15] Groff & Clark in Univ. Calif. Pub. Bot. **14**: 247–282, *charts 1–6.* 1928.

[16] Nelson in Am. Jour. Bot. **21**: 573. 1935.

[17] Coville & Morton in Jour. Wash. Acad. Sci. **25**: 307. 1935.

[18] Reed in Bull. Torr. Bot. Club **62**: 43. 1935.

[19] Reed in Bull. Torr. Bot. Club **63**: 351, *figs. 1–2.* 1936.

[20] Cory in Rhodora **40**: 218. 1938.

Torreyana the endosperm remains attached to the base of the stem by means of a foot, although Voth[21] indicates that *Ephedra* is the only Gnetalean genus lacking this organ.

From 420 seeds of *E. trifurca, E. Torreyana, E. antisyphilitica, E. aspera, E. Coryi* var. *viscida* and *E. viridis,* in about equal numbers gathered in May and June and planted in September, only eleven seedlings were obtained, nine of *E. Torreyana* and one each of *E. trifurca* and *E. Coryi* var. *viscida.*

No seedlings and only a very few young plants were observed during two seasons of field work, and it is probable that the most frequent type of propagation is by means of divisions of buried stems. It has been suggested that the peridermal diaphragm at the base of each internode which allows the stems to fragment readily is a device to aid propagation by the rooting of the segments. It is highly improbable that many of these segments would root under the xerophytic conditions characteristic of the habitat of *Ephedra.*

Stem.—The green stem is solid, furrowed, and usually roughened by the cutinized and thickened epidermal walls which contain calcium oxalate. Blunt papillae occur on the thickened walls, and the size and number of these determine the degree of asperity of the stem. While the papillae vary greatly within a species, the width of the furrows and ridges and the number of stomata per unit of area remain nearly constant. The epidermal cells upon the ridges are longer than those in the furrows and are underlain by a bundle of hypodermal fibers.

In most species the stomata are confined to the furrows and usually are sunken, although in *E. antisyphilitica, E. compacta* and *E. pedunculata* the striation is not extensive and the stomata are scattered over the entire surface. The stomatal pits are prominent in these three species, especially in *E. compacta.* The size and shape of the stomata vary with the species.

Stomatal frequencies are relatively constant for each species, provided stems of the same age and from plants in almost similar habitats are examined. While it would be better to use the stomatal index ($I = \frac{s}{e-s} \times 100$, where s is the frequency of stomata and e the frequency of epidermal cells in the same unit area) selection of the material to be examined makes it possible to secure figures subject to only slightly greater variation. The cells on the edges of the ridges are difficult to see without special preparation, but Pont[22] in studies on two species of plants did not count the epidermal cells upon the ridges. Frequently, however, it is difficult to distinguish between the cells of the furrows and those of the edges of the ridges, although the latter are usually longer.

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[21] Voth in Bot. Gaz. **96**: 298. 1934.

By utilizing supplementary characters such as those just mentioned it is possible to identify almost any specimen of *Ephedra* from North America. Table I lists figures which will aid in the determination of vegetative as well as staminate and ovulate material.

The outer layers of cortical cells are chlorophyll-bearing and include numerous air spaces. Starch grains, calcium oxalate crystals and tannin are enclosed within many of these cells. Three systems of fibers are distinguished in this region by Graham[23]: the hypodermal, which underlies the ridges, as hitherto mentioned; the mesocortical, which is scattered through the cortex; and the pericyclic, which is scattered about on the periphery of the stele with the largest fibers abutting the vascular strands. The hypodermal fibers and those of the pericycle which adjoin the vascular bundles are the most constant in numbers and in size. At the nodes this fiber system is interrupted.

Lignified cells and fibers are found in the pith, and a peridermal diaphragm is produced at the base of each internode, which, with the interruption of the fiber system, allows ready fragmentation of the stems.

The stele is an endarch siphonostele with a slight variation in the numbers of bundles. Those species characterized by ternate arrangement of the leaves and bracts have three pairs

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[22] Pont in Beih. z. Bot. Centr. **59**: 214–224, *6 figs.* 1939.

[23] Graham in Trans. Roy. Soc. Edinb. **46**: 203–212, *3 pls.* 1909.

TABLE I

COMPARISON OF NORTH AMERICAN EPHEDRAS

	Average length of internode in cm.	Number of leaves or bracts in a whorl	Average angle of branch divergence in degrees	Number of vascular bundles in a stem	Number of hypodermal fiber strands	Number of cells in a cross-section of a fiber strand	Number of stomata per sq. mm.	Ovulate bracts: membranaceous, herbaceous or fleshy	Number of seeds in strobilus	Peduncle of ovulate strobilus: present or absent	Usual number of anthers on antherophore
1. *E. trifurca*	3.6	3	30	12–15	40	28	108	mem.	1–3	ab.	5
2. × *E. intermixta*	2.6	3	35–40	15	36	11	120	mem.	1–3	ab.	4–7
3. *E. Torreyana*	2.4	3	48	12–15	48	4	88	mem.	1–3	ab.	7
4. × *E. arenicola*	3.5	2–3	35	10–12	34	14	50	mem.	1–3	pr.	6
5. *E. funerea*	4.	3	60	12–15	60	5	84	mem.	1–3	ab.	7
6. *E. californica*	3.8	3	45	12–15	36	9	92	mem.	1	ab.	7
7. *E. aspera*	3.	2	35	10	40	10	68	mem.	1	ab.	5
8. *E. fasciculata*	2.5	2	35	10	48	4	72	mem.	1	ab.	6
9. *E. Clokeyi*	3.	2	40	10	50	7	48	mem.	1	ab.	6
10. *E. nevadensis*	2.8	2	45	10	56	7	84	herb.	2	pr.	8
10a. *E. nevadensis* f. *rosea*	2.8	2	42	10	40	9	60	herb.	2	pr.	–
11. *E. viridis*	2.5	2	33	8–10	39	7	52	mem.	2	pr.	7
12. *E. Coryi*	2.5	2	22	8–10	34	12	48	flsh.	2	pr.	7
12a. *E. Coryi* var. *viscida*	3.6	2	28	10	35	16	52	herb.	2	pr.	6
13. *E. antisyphilitica*	2.8	2	48	10	20	5	76	flsh.	1	ab.	6
13a. *E. antisyphilitica* var. *brachycarpa*		2							1		
14. *E. compacta*	2.	2	37	10	12	14	96	flsh.	2	ab.	–
15. *E. pedunculata*	4.	2	52	8–10	18	12	56	flsh.	2	pr.	6

or three groups of three small bundles. In forms with binate arrangement of parts the vascular system consists of two pairs of large bundles alternating with two pairs or with three groups of three small bundles.

The xylem consists of spiral primary elements and secondary tracheids and vessels with bordered pits. These last are modified tracheids, and the oblique end walls have bordered pits larger than those on the lateral walls. These pits enlarge to lose both torus and border and occasionally fuse.[24]

The primary phloem consists of cambiform parenchyma elements and narrow sieve-tubes with oblique plates.

The wood rays are large, uniseriate in young wood, multiseriate in older branches, and consist of storage parenchyma and transformed longitudinal fibers. The pits are small and simple. Depressions in the wood correspond to the positions of the large rays. There is no apparent relation between the position of the rays and that of the leaf traces.

The angle formed by the branches with the stem in any species is relatively constant, although the amount of branching and the length of branches and of internodes are variable within limits for each species and are altered by changes in environmental conditions.

Leaves.—The leaves are small, scale-like, and usually connate. The median and basal portions are thickened, and an abscission layer developed near the base renders the leaf caducous in most species. The leaves are either opposite or ternate and the whorls alternate.

Strobili.—All the North American species are essentially dioecious, but it is often possible to find a plant of any species which bears strobili of both types. I have also seen bisporangiate strobili on otherwise staminate plants of *E. trifurca, E. Torreyana, E. aspera* and *E. Clokeyi.* Bisporangiate strobili were not found on ovulate plants. Apparent sexual differentiation is confined to the peduncles and strobili.

The staminate strobili are compound and borne in pairs or whorls at the nodes of the young branches, or rarely terminally. They consist of an axis bearing 2–13 whorls of binately or ternately arranged bracts, all except the lower subtending a vasiform perianth which surrounds a staminal column. Upon this column, or sporangiophore, are borne the three to twelve usually bilocular anthers which may be sessile or stipitate. The column in some species is very variable. In *E. Clokeyi* it may attain a length three times the normal, and in *E. Torreyana* a slender column may bear one uniloculate anther or a branched column may bear up to ten bi- and triloculate anthers. The bract and perianth are more constant in size within the species, and outlines of these and typical columns are figured in plate 27.

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[24] Jeffrey, The anatomy of woody plants, p. 367. 1917.

The ovulate strobili are solitary or whorled at the nodes of the young branches and may be sessile or long-pedunculate. Three to twenty whorls of membranaceous to fleshy bracts surround the one to four ovules. The ovule is enclosed by two integuments, the inner extending through an opening of the outer to form a tubillus which leads to the pollen chamber at the tip of the ovule. Although the form of the tubillus was used as a character in the delimitation of species by both Meyer and Stapf, it varies somewhat in most of the American species and is not of great value as a diagnostic character. The length of the peduncle, the number, shape, size and texture of the bracts, and the character and numbers of seeds (pl. 27) are the most valuable characters in delimitation of species.

Phylogeny and Geographical Distribution

It is possible to trace a probable course of evolutionary development among the American species of *Ephedra*, but such speculation is of little value unless based upon a thorough knowledge of the entire genus. The apparent differences between species of even separate continents are often so slight that all must be considered in any theorizing upon developmental sequences. The key to the species is artificial, and the entities are grouped only so that the most similar ones are close together.

The distribution maps (pl. 28) are fairly accurate with the exception of Nevada and Mexico, where an insufficient number of collections have been made. The region of greatest specific concentration for North America is in west-central Arizona where seven of the eighteen entities occur.

Acknowledgments

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Entire or partial collections of *Ephedra* were borrowed from several institutional and private herbaria, and certain herbaria were visited. To these institutions and individuals the author wishes to express his gratitude. These herbaria are indicated in the text by the following abbreviations:

(BYU) —Brigham Young University.
(Buf) —Buffalo Museum of Science.
(CA) —California Academy of Sciences.
(Clo) —Herbarium of I. W. Clokey.
(F) —Field Museum of Natural History.
(G) —Gray Herbarium of Harvard University.
(I) —Iowa State College.
(M) —Missouri Botanical Garden.
(NMAM)—New Mexico State College of Agriculture and Mechanic Arts.
(P) —Pomona College.
(R) —Rocky Mountain Herbarium of the University of Wyoming.
(S) —Leland Stanford University.
(SD) —San Diego Natural History Museum.
(T) —Agricultural and Mechanical College of Texas.

(TTC) —Texas Technological College.
(UC) —University of California.
(UI) —University of Iowa.
(UNM) —University of New Mexico.
(UW) —University of Wisconsin.
(US) —United States National Herbarium.

Taxonomy

Ephedra [Tourn.] L., Sp. Pl. **2**: 1040. 1753; Gen. Pl., ed. 5, 462. 1754; C. A. Meyer in Mem. Acad. Imp. Sci. St. Petersburg, VI, Sci. Nat. **5**: 291. 1846; Endlicher, Syn. Conif. 253. 1847; Torr. in Emory, Mil. Reconn. 151. 1848; Torr. in Emory, Rep. U. S. & Mex. Bound. Surv. **2**: 207. 1859; Parl. in DC., Prodr. **16**^{2}: 352. 1868; Wats. in U. S. Geol. Surv. Fortieth Parallel [Bot. King's Exp.] **5**: 328. 1871; Parry in Am. Nat. **9**: 351. 1875; Wats. in Proc. Am. Acad. **14**: 298. 1879; Wats., Bot. Geol. Surv. Calif. **2**: 108. 1880; Wats. in Proc. Am. Acad. **18**: 157. 1883; Stapf in Denkschr. K. Akad. Wiss. Wien **56**^{2}: 1. 1889; Coult. in Contrib. U. S. Nat. Herb. **2**: 552. 1894; Rydb. in Colo. Agr. Exp. Sta. Bull. [Fl. Colo.] 100: 10. 1906; Rose in Contrib. U. S. Nat. Herb. **12**: 261. 1909; Coult. & Nels., Man. Rky. Mt. Bot. 19. 1909; Jepson, Fl. Calif. 65. 1912; Wooton & Standl. in Contrib. U. S. Nat. Herb. **19**: 38. 1915; Goldman in Contrib. U. S. Nat. Herb. **16**: 315. 1916; Rydb., Fl. Rky. Mts. and Adj. Plains, ed. 1, 19. 1918, ed. 2, 19. 1923; Standl. in Contrib. U. S. Nat. Herb. **23**: 63. 1920; Johnston in Univ. Calif. Pub. Bot. **7**: 437. 1922; Abrams, Ill. Fl. Pac. States, 77. 1923; Davidson & Moxley, Fl. So. Calif. 31. 1923; Jepson, Man. Fl. Pl. Calif. 61. 1925; Tidest. in Contrib. U. S. Nat. Herb. **25**: 56. 1925; Rehder, Man. Cult. Trees & Shrubs, 67. 1927; Groff & Clark in Univ. Calif. Pub. Bot. **14**: 247. 1928; George, Supp. aux Mém. Soc. Sci. Nancy **1930**: 29. 1930; Coville & Morton in Jour. Wash. Acad. Sci. **25**: 307. 1935; Jepson, Man. So. Calif. Bot. 19. 1935; Nelson in Am. Jour. Bot. **21**: 573. 1935; Reed in Bull. Torr. Bot. Club **62**: 43. 1935; Reed in Bull. Torr. Bot. Club **63**: 351. 1936; Cory in Rhodora **40**: 216. 1938.

Chaetocladus Senilis [=Nelson] Pinac. 161. 1866.

Erect or clambering, dioecious or rarely monoecious shrubs; branches equisetoid, solitary, or whorled; vascular cylinder an endarch siphonostele; wood rays large, uniseriate in young wood, multiseriate in older branches, composed of storage parenchyma and transformed longitudinal wood fibers; wood containing vessels with oblique terminal walls perforated by numerous pits larger than those on lateral walls, the membranes of these terminal pits lost at an early stage, the pits occasionally fused to form slits; leaves binate or ternate, small, usually united to form a sheath; staminate strobili compound, binately or ternately whorled bracts including a vasiform structure composed of the base of the antherophore upon which are borne the few to many usually biloculate sessile to short-stipitate anthers; ovulate strobili with few to many whorls of binately or ternately arranged membranaceous to fleshy bracts surrounding the one to several ovules, the inner integument extended to form a cylindrical projecting tubillus; two archegonia usually present.

Type species: *Ephedra distachya* L., Sp. Pl. **2**: 1040. 1753.

ARTIFICIAL KEY

A. Leaves and bracts of spikes ternate.

B. Leaves becoming shredded and gray with age, persistent; terminal buds spinose.

C. Leaves more than 8 mm. long............................*1. E. trifurca*

CC. Leaves less than 8 mm. long..........................*2. E. intermixta*

BB. Leaves remaining firm or falling off with age; terminal buds not spinose.

D. Seeds less than one-half as wide as long, cream to light brown, rough and angular.

E. Ovulate bracts as broad as long or broader; east of California..*3. E. Torreyana*

EE. Ovulate bracts two-thirds as broad as long or less; Death Valley region to Nevada.....................................*5. E. funerea*

DD. Seeds more than one-half as wide as long, brown, smooth and almost spherical...*6. E. californica*

AA. Leaves and bracts of spikes binate, occasionally ternate.

F. Inner bracts of the ovulate spike membranaceous or herbaceous.

G. Seeds solitary, or if more than one, light in color.

H. Seeds almost circular in cross-section.

I. Seeds smooth, brown to chestnut in color; leaf-bases brown and persistent; stem usually rough............................*7. E. aspera*

II. Seeds furrowed or scabrous, light brown to gray-green; leaf-bases gray and deciduous; stem usually almost smooth.
  J. Seeds more than 9 mm. long....................*8. E. fasciculata*
  JJ. Seeds less than 9 mm. long........................*9. E. Clokeyi*
HH. Seeds trigonal or tetragonal in cross-section..........*4. E. arenicola*
GG. Seeds paired, brown to almost black.
  K. Ovulate spikes sessile or very short-pedunculate; seeds lightly furrowed longitudinally; leaf-bases brown................*11. E. viridis*
  KK. Ovulate spikes usually long-pedunculate; seeds usually smooth; leaf-bases gray or brown.
    L. Leaf-bases deciduous and gray; seeds about one-half as thick as long; stem not viscid.
      M. Seeds more than 5 mm. in length, slightly exserted, chestnut; bracts with a faint trace of pink..............*10. E. nevadensis*
      MM. Seeds 5 mm. or less in length, almost included, nearly black; bracts bright pink to rose............*10a. E. nevadensis* f. *rosea*
    LL. Leaf-bases persistent and brown; seeds less than one-half as thick as long; stem viscid..............*12a. E. Coryi* var. *viscida*
FF. Inner bracts of the ovulate spike becoming fleshy; eastern Mexico and United States east of Central New Mexico.
  N. Seeds solitary.
    O. Seed never less than 6 mm. long, less than 3 mm. broad, slightly exserted....................................*13. E. antisyphilitica*
    OO. Seed less than 6 mm. long, about 3 mm. broad, included.......... ....*13a. E. antisyphilitica* var. *brachycarpa*
  NN. Seeds paired.
    P. Bracts red; leaf-bases gray and deciduous.
      Q. Low compact shrubs, not clambering; ovulate spikes sessile; anthers not known...............................*14. E. compacta*
      QQ. Clambering shrubs; ovulate spikes pedunculate; anthers long-stipitate....................................*15. E. pedunculata*
    PP. Bracts yellow to orange; leaf-bases brown and persistent........ ....*12. E. Coryi*

1. **Ephedra trifurca** Torr. ex Wats. in U. S. Geol. Surv. Fortieth Parallel [Bot. King's Exp.] **5**: 329. 1871.

E. occidentalis Torr. in Emory, Mil. Reconn. 151. 1848 [in error, evidently intended for *E. americana* Willd.].

E. trifurcus Torr. in Emory, Mil. Reconn. 152. 1848.

E. antisyphilitica Torr. in Emory, Rep. U. S. Mex. Bound. Surv. **2**: 207. 1859, in part.

E. trifaria Parl. in DC., Prodr. **16**^{2}: 359. 1868.

Erect dioecious shrub, 0.5–2 m. high; branches rigid, hard, terete, up to 3.5 mm. thick, solitary or whorled at the nodes, angle of divergence with the main stem about 30 degrees; internodes 3–9 cm. long; bark of young stems pale green, almost smooth, with numerous small longitudinal furrows, becoming yellow, then gray-green; bark of older stems cinereous, cracked and somewhat irregularly fissured longitudinally; terminal buds 1 cm. long, spinose; leaves ternately whorled, 5–13 mm. long, subspinosely tipped from a dorso-median thickening, connate for one-half to three-fourths their total length; sheath at first membranaceous, later fibrous, shredded and grayish, persistent; staminate spikes solitary or numerous in a whorl at the nodes of the young branches, obovate, 6–9 mm. long, short-pedunculate, peduncles many-scaled, bracts ternate, in 8–12 whorls, obovate, slightly clawed, 3–4 mm. long, 2–3 mm. broad, membranaceous, reddish-brown, the lower whorls empty; perianth almost equaling the subtending bract; staminal column 4–5 mm. long, one-fourth exserted, with 4–5 short-stipitate anthers; ovulate spikes solitary or numerous in a whorl at the nodes of the young branches, obovate, 10–14 mm. long, short- and scaly-pedunculate or sessile, bracts ternate, in 6–9 whorls, orbicular, clawed, 8–12 mm. long, 9–12 mm. broad, translucent except for the reddish-brown center and basal portion, margins entire; fruit solitary or, occasionally, two or three, usually tetragonal, light brown, smooth, 9–14 mm. long, 1.5–3 mm. wide, equaling the bracts; tubillus straight, conspicuously exserted, the twisted ligulate limb 1 mm. long.

Distribution: southwestern Texas and southern New Mexico to California, and adjacent Mexico.

SPECIMENS EXAMINED:

TEXAS: Limpia Canyon, May 1915, *Allen 177* (G, M); in gravel, semidesert foothills, Franklin Mts., Canutillo, El Paso Co., 3 July 1911, *Barlow* (F); sandy places near El Paso, *Bigelow 3* (G); plain, 3 miles east of Casa Piedra, Presidio Co., 21 Feb. 1937, *Cutler 622* (G, M, P, UW); sands west of gap, Dog Canyon, Santiago Mts., Brewster Co., 27 May 1938, *Cutler 1852–1859* (M); along creek bottom, 3 miles southeast of Castolon, Brewster Co., 29 May 1938, *Cutler 1877, 1879, 1881* (M); sandy plain, 8 miles northwest of Presidio, Presidio Co., 31 May 1938, *Cutler 1920* (M); along dry creek, 17 miles north of Shafter, Presidio Co., 1 June 1938, *Cutler 1942, 1943* (M); along railroad, 2 miles west of Marfa, Presidio Co., 1 June 1938, *Cutler 1952* (M); in sand, forming hummocks, 12 miles northeast of El Paso, El Paso Co., 4 June 1938, *Cutler 1980–1982* (M); flats near Van Horn, 12 May 1901, *Eggert* (M); Mt. Livermore, May 1936, *Hinckley 257* (F); El Paso, 17 April 1884, *Jones 3717* (CA, F, NMAM, P); Marathon, 23 April 1930, *Jones*

26403 (M, P); about 5 miles west of Alpine, Brewster Co., 25 April 1931, *McKelvey 1997, 1998* (P); Boquillas, Brewster Co., 20 July 1937, *Marsh 143* (F); gravelly plain, 3 miles west of Mt. Livermore, Davis Mts., alt. 1800 m., 14 June 1931, *Moore & Steyermark 3083* (CA, G, M); gravelly desert, west side of Chisos Mts., alt. 1065 m., Brewster Co., 27 June 1931, *Moore & Steyermark 3287* (CA, G, M); Hueco Tanks, 1 July 1895, *Mulford 187, 187a* (M); low hills near Fort Davis, 7 July 1917, *Munz 1408* (P); rocky open ground, upper Limpia Canyon, Jeff Davis Co., 17 June 1926, *Palmer 30989* (M); Barstow, 18 April 1902, *Tracy & Earle 66* (F, M); Allamore, 23 April 1932, *Whitehouse 8339* (F).

NEW MEXICO: sandy fields, 7 miles north-northeast of Oro Grand, Otero Co., 4 June 1938, *Cutler 1983, 1984* (M); along creek bed, Rhodes Pass, 30 miles east of Engle, 5 June 1938, *Cutler 2019* (M); fields, 3 miles west of Elephant Butte Dam, Sierra Co., 7 June 1938, *Cutler 2068–2074* (M); on creosote-bush desert near San Marcial, 23 Feb. 1934, *Detwiler 21* (F); near Silver City, 3 April 1919, *Eastwood 8192, 8193* (CA); Nutt, 1420 m., Luna Co., 6 Oct. 1919, *Eggleston 16269* (F); along the Gila River and on the mesa above Cliff, Grant Co., 24 Oct. 1919, *Eggleston 16508* (M); "From the region between the Del Norte and the Gila, and the hills bordering the latter river to the desert west of the Colorado," *Emory Exp.* (TYPE, not seen); wash, 3 miles west of Pyramid Peak, alt. 1200 m., Dona Ana Co., 29 Aug. 1930, *Fosberg S3474* (P); Deming, 11 Aug. 1936, *Gaines* (UNM); Socorro, 1880, *Greene* (F); Lordsburg, 9 April 1930, *Jones 25966* (P); Deming, 9 April 1930, *Jones 26402* (M, P); Organ Mts., Las Cruces, Sept. 1931, *Layton* (I); Mangas Springs, 18 miles northwest of Silver City, Grant Co., 26 Sept. 1903, *Metcalfe 811* (M); hillside near Albuquerque, alt. 1200 m., 17 Dec. 1936, *Miers* (UNM); Deming, 31 Aug. 1895, *Mulford 1025* (I, M); dry rocky hills along the Rio Grande near Caballo Dam, 17 miles east of Hillsboro, Sierra Co., 15 June 1938, *Ownbey & Ownbey 1633* (M); desert plain 8 miles northeast of Lordsburg, Hidalgo Co., 19 June 1938, *Ownbey & Ownbey 1647* (M); Dry Canyon, Sacramento Mts., Alamogordo, alt. 1400 m., 9 April 1902, *Rehn & Viereck* (P, R); San Antonio, 1883, *Rusby* (F); mesa west of Agricultural College, 3 May 1906, *Standley 38* (M); mesa, west of Organ Mts., 22 June 1906, *Standley 441* (M); sandy soil, Valverde, 31 July 1846, *Wislizenus 58* (M); mesa, near Las Cruces, 10 May 1892, *Wooton 426* (NMAM); mesa, near Las Cruces, alt. 1250 m., 5 July 1897, *Wooton 96* (G, M, P); mesa, west of the Organ Mts., Dona Ana Co., 22 April 1899, *Wooton* (NMAM); mesa, west of Organ Mts., Dona Ana Co., alt. 1230 m., 19 April 1905, *Wooton* (I, NMAM); Frontera and Donnana, coll. of 1851–52, *Wright 1884* (G, M).

ARIZONA: San Bernardino Valley, alt. 1230 m., Cochise Co., 18 April 1928, *Ballou* (CA, P); mesa, north of Rillito Creek, Pima Co., 16 Jan. 1920, *Bartram 16* (P); Yuma, 3 April 1914, *Carlson* (CA); highway 60, near Globe, 1050 m., Gila Co., 21 April 1935, *Collom 341* (M); Yuma, 22 April 1917, *Eastwood 6348* (CA); canyon, Santa Rita Mts., Tucson, 22 March 1919, *Eastwood 8115* (CA); Bowie, 16 May 1919, *Eastwood 8624* (CA); along road from Packard to Payson, 1 Nov. 1928, *Eastwood 16606* (CA); on the road from Prescott to Phoenix, 11 Nov. 1928, *Eastwood 16608* (CA); Sierra Ancha, 7 May 1929, *Eastwood 16950* (CA); Mazatzal Mts., 12 May 1929, *Eastwood 17169* (CA); on road between Globe and Roosevelt, 24 May 1929, *Eastwood 17447* (CA); Pinal Mts., 18 May 1929, *Eastwood 17526* (CA); on road to Rincon Mts., 19 March 1930, *Eastwood 17805, 17811* (CA, G);

Cochise, Feb. 1927, *Ellis & Ledman* (M); on the mesa, north of the Santa Rita Mts., 28 Sept. 1880, *Engelmann* (M); Roadside Mine, Pima Co., 3 April 1932, *Fosberg* (M, P); Douglas, 22 May 1907, *Goodding 2268* (M); desert "prairie," north of Tucson, 4 April 1913, *Greenman & Greenman 74* (M); small range reservation near Tucson, 13 March to 23 April 1903, *Griffiths 3534* (M); Congress Junction, alt. 900 m., 2 May 1903, *Jones* (P); Oracle, alt. 1400 m., 28 Aug. 1903, *Jones* (P); Rodeo, 8 April 1930, *Jones 26400* (M, P); Stein's, 6 May 1930, *Jones 25965* (CA, M, P); Benson, 6 April 1930, *Jones 26401* (P); Sulphur Springs Valley, 18 May 1921, *W. W. Jones 434* (G); mesas, near Tucson, spring 1907, *Lloyd* (F, G); Yuma desert at Monument 204, International Boundary, 17 March 1894, *Mearns 2826* (S); sand dunes, south of Wellton, Gila Desert, Jan. 1916, *Monnet 1110* (CA); rocky washes, 25 miles west of Casa Grande City, 22 March 1935, *Nelson & Nelson 1259* (M, R); sandy Yuma desert near U.S.-Mexican boundary, 26 March 1935, *Nelson & Nelson 1290* (M, R); near Cochise, 24 April 1935, *Nelson & Nelson 1619* (M); Tucson, 2 Feb. 1926, *Nuttall* (CA, F, P); Mohave Agency, 1 April 1876, *Palmer 523½* (G, M); Yuma, 20 March 1881, *Parish & Parish 753* (F, G); Tucson, April 1884, *Parish* (M); Lowell, May 1884, *Parish* (I); Sulphur Springs Valley, 13 April 1894, *Price* (S); mesas, 29 April 1881, *Pringle* (F, G, M); mesa, near Tucson, 2 April 1883, *Pringle* (F); mesa, near Tucson, 21 April 1884, *Pringle* (F); Metcalf, near Clifton, *Reynolds* (CA); wash, west of Desert Lab., Tucson, 22 June 1908, *Sherff* (F); mesas, near Tucson, 8 April 1917, *Shreve 5158* (G); 5 miles west of Rodeo, Cochise Co., 30 April 1933, *Shreve 6282* (F); Gila, June 1852, *Thurber 681* (G); in sand, 7 miles south of Parker on the Bouse road, Yuma Co., 14 April 1922, *Wiegand & Upton 2979* (F); flats of Desert Lab., Tucson, 15 March 1933, *Wiggins 6508* (P); 42 miles northeast of Douglas on road to Rodeo, alt. 1350 m., 7 July 1928, *Wolf 2555* (CA, G, P).

CALIFORNIA: near Salton Sea, 6 March 1922, *Campbell* (CA, P); sand hills, Yuma-El Centro road, Imperial Co., 19 April 1928, *Ferris 7128* (P); Yaqui Well, Colorado Desert, 21 Jan. 1926, *Jones* (P); Imperial Co., near Arizona, 13 March 1920, *Kline* (UW); sand dunes between El Centro, Imperial Co., and Yuma, Arizona, 25 March 1936, *MacFadden 14476* (CA); Laguna Station, 6 May 1894, *Mearns 2937* (S); under overhanging rocks, foot of Mountain Springs Grade, Imperial Co., 23 Feb. 1924, *Munz 7823* (G, P); Colorado desert near Yuma, 27 Dec. 1880, *Parry* (I, M); Agua Caliente, April 1882, *Parry* (M); sand dunes, west of Fort Yuma, Imperial Co., 15 April 1927, *Peirson 7193* (P); sandy soil, Colorado Desert, 12 miles northwest of Westmorland, below sea-level, Imperial Co., 12 March 1931, *Wolf 1870, 1871* (CA).

MEXICO:

COAHUILA: Del Carmen Mts., 29 Aug. 1936, *Marsh 694* (F).

CHIHUAHUA: San Diego, alt. 1830 m., 10 April 1891, *Hartman 642* (G, US); Sierra Madre, 21 June–29 July 1899, *Nelson 6014* (US); vicinity of Chihuahua, about 1300 m., 8–27 April 1908, *Palmer 68* (F, G, M, US); vicinity of Chihuahua, about 1300 m., 1–21 May 1908, *Palmer 172* (US); Chihuahua, 1885, *Pringle 88* (G); mesas, near Chihuahua, 7 April 1886, *Pringle 868* (F, US); mesas, Chihuahua, 20 May 1887, *Pringle 1589* (F); 11 May 1899, *Rose & Hough 4928* (US); Sta. Eulalia plains, 13 April 1885, *Wilkinson 117* (I, US), in part; Sta. Eulalia plains, 2 April 1886, *Wilkinson 120* (I, US).

SONORA: coast of Gulf of California near upper end, 1910, *Lumholtz 24* (G); Colorado River at Colonia Diaz, 24 March 1894, *Mearns 417* (US); Lower Colorado, 1869, *Palmer* (US).

BAJA CALIFORNIA: Gardner's Laguna, 27 April 1894, *Mearns & Schoenfeldt 2916* (S).

E. trifurca is easily recognized by the yellowed and spinosely-tipped branches and the frayed but persistent leaves of the older stems. The species is very constant throughout its entire range.

2. × **Ephedra intermixta** Cutler,[25] n. hyb.
(= *Ephedra trifurca* × *Torreyana*).

Erect dioecious shrub, 0.5–1.5 m. high; branches rigid, solid, terete, up to 3.5 mm. thick, solitary or whorled at the nodes, angle of divergence 35–40 degrees; internodes 1–5 cm. long; young stems pale green, smooth and glaucous, with numerous small longitudinal furrows, becoming yellowed; bark cinereous, cracked and fissured; terminal buds spinose to obtuse-conical; leaves ternate, 3–6 mm. long, acutely tipped from a dorso-median thickening, connate for three-fourths their length at first, soon splitting; sheath membranaceous, later fissured; staminate spikes at the nodes of the young branches, ovate, 3–7 mm. long, sessile or short-pedunculate, bracts ternate, in 3–7 whorls, obovate, 2–3 mm. long, 2 mm. broad, membranaceous, light yellow to light brown, the lower whorls empty; perianth almost equaling the subtending bract; staminal column 2–5 mm. long, one-half exserted, with 4–7 short-stipitate anthers; ovulate spikes solitary or numerous at the nodes of the young branches, obovate, 4–7 mm. long, sessile or short pedunculate, bracts ternate, in 5–7 whorls, suborbicular, unguiculate, hyaline margins erose, 4–7 mm. long, 4–6 mm. broad, membranaceous, light yellow; seed usually solitary, tri- or tetragonal, light brown, smooth, 4–6 mm. long; tubillus straight, conspicuously exserted, the ligulate limb contorted.

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[25] × **Ephedra intermixta** Cutler, hyb. nov.; frutex erectus, dioiceus, 0.5–1.5 m. altus; ramulis rigidis, solidis, teretibus, usque ad 3.5 mm. in diametro, ad nodos solitariis vel verticillatis, angulo declinationis circiter 35–40°; internodiis 1–5 cm. longis; caulibus juventate pallide viridibus, laevibus et glaucis, tenuissime striatis, deinde lutescentibus; rhytidoma cinerea, rimosa, sulcata; gemmis terminalibus pungentibus vel conicis; foliis ternatis, 3–6 mm. longis, ad apicem pungentibus ex dorso-medio crassificatione, primo ad ¾ longitudinis connatis, deinde diffisis; vagina membranacea, deinde corruta; spicis stamineis solitariis vel multis ad nodos ramulorum novorum, ovatis, 3–7 mm. longis, sessilibus vel brevi-pedunculatis, bracteis ternatis, in 3–7 verticillis, obovatis, 2–3 mm. longis, 2 mm. latis, membranaceis, pallide luteis vel pallide fulvis, verticillis inferioribus vacuis; perianthis bracteas subtendentes subaequantibus; columna staminalis 2–5 mm. longa, ½ exserta, 4–7 antheris brevi-stipitatis; spicis femineis solitariis vel multis ad nodos ramulorum novorum, obovatis, 4–7 mm. longis, sessilibus vel brevi-pedunculatis, bracteis ternatis, in verticillis 5–7, suborbicularibus, unguiculatis, marginibus hyalinis, erosis, 4–7 mm. longis, 4–6 mm. latis, membranaceis, pallide luteis; seminibus plerumque solitariis, tri- aut tetragonatis, pallide fulvis, laevibus, 4–6 mm. longis; tubillo recto, multo exserto, limbo ligulato contorto.

SPECIMENS EXAMINED:

NEW MEXICO: creek bed, Rhodes Pass 30 miles east of Engle, 5 June 1938, *Cutler 2020, 2021* (G, M, US); fields, 3 miles west of Elephant Butte Dam, Sierra Co., 7 June 1938, *Cutler 2075* (G, M TYPE, T, US), *2078* (G, M, T, US).

While making field studies several cases of possible hybridization were observed. Specimens intermediate between *E. trifurca* and *E. Torreyana* were collected both in sandy washes and creek beds, the usual habitat of *E. trifurca,* and in gravelly and sandy fields, the habitat of *E. Torreyana.* The preference of stock for the latter and for *E. intermixta* aids in the field of identification of these two. A comparison with the parent species follows:

E. trifurca	× *E. intermixta*	*E. Torreyana*
Scarcely ever eaten by stock.	Eaten by stock.	Eaten by stock.
Numerous branches at a node.	Numerous to few at a node.	Few branches at a node.
Angle of branch-divergence about 30°.	Angle of branch-divergence about 35–40°.	Angle of branch-divergence about 48°.
Average internode 3.6 cm.	Average internode 2.6 cm.	Average internode 2.4 cm.
Leaves up to 10 mm. long.	Leaves up to 6 mm. long.	Leaves up to 3.5 mm. long.
Bracts usually brown, margins entire.	Bracts from brown and entire to yellow and erose.	Bracts usually yellow, margins erose.
Seeds smooth and light brown.	Seeds smooth and light brown.	Seeds scabrous and light yellow.

3. **Ephedra Torreyana** Watson in Proc. Am. Acad. **14**: 299. 1879.

E. trifurca Parry in Am. Nat. **9**: 351. 1875.

E. antisyphilitica f. *monstrosa* Torr. ex Stapf in Denkschr. K. Akad. Wiss. Wien **56**^{2}: 43. 1889.

Erect dioecious shrub, 0.25–1 m. high; branches rigid, hard, terete, up to 3.5 mm. thick, solitary or whorled at the nodes, angle of divergence about 48°; internodes 2–5 cm. long; young stems pale blue-green, glaucous, almost smooth with many small longitudinal furrows, becoming gray; bark of older stems cinereous, cracked and irregularly fissured; terminal buds less than 4 mm. long, conical but not spinose; leaves ternately whorled, 2–5 mm. long, obtusely, occasionally acutely, pointed from a brownish-green dorso-median thickening, connate for one- to two-thirds their total length, but later spreading and recurved; sheath at first membranaceous, later fissured, thickened and grayed, subpersistent; staminate spikes solitary to four in a whorl at the nodes of the young branches, ovate, 6–8 mm. long, sessile; bracts ternate, in 6–9 whorls, ovate, slightly clawed, 2–3.5 mm. long, 2-3 mm. broad, membranaceous, cream-coloured to pale yellow, the lower whorls empty; perianth exceeding the subtending bract; staminal column 2.5–4 mm. long, one-fourth to one-half exserted, with 5–8 sessile or short-stipitate anthers; ovulate spikes solitary or several in a whorl at the nodes of the young branches, ovate, 9–13 mm. long, sessile, bracts ternate, in 5–6 whorls, obovate, clawed, 6–9 mm. long, 6–10 mm. broad, hyaline except for the orange-yellow to greenish-yellow center and basal portion, margins minutely toothed, undulate; seed solitary or two, occasionally three, trigonal or tetragonal, light brown to yellow-green, scabrous, 7–10 mm. long, 1.6–3 mm. wide, equaling or slightly exceeding the bracts; tubillus straight, conspicuously exserted, the contorted ligulate limb 1 mm. long.

Distribution: western Colorado to western Texas and westward to northern Arizona and Nevada.

Specimens examined:

Texas: cottonwoods near El Paso, *Bigelow 4* (G, M); 11.15 miles southwest of Big Springs, Howard Co., 18 April 1930 *Cory 2829* (P); dry steep calcium breaks of Palo Duro Canyon, Randall Co., 31 July 1934, *Goodman 2230* (M); dry rocky slopes of Palo Duro Canyon, Randall Co., 3 June 1918, *Palmer 13873* (M, UW); dry rocky slopes, Channing, Hartley Co., 19 June 1918, *Palmer 14155* (M, UW);

Frontera, 1852, *Parry* (M); sandy hills near Frontera, 26 April 1851, ***Wright 1883*** (G TYPE, M) in part.

COLORADO: Deer Run, region of the Gunnison Watershed, alt. 1430 m., 25 Aug. 1901, *Baker 921* (G, M); Grand Junction, May 1892, *Eastwood* (C); Grand Junction, alt. 1370 m., 21 June 1894, *Jones 5468* (F, M, P); Grand Junction, alt. 1350 m., 9 May 1895, *Jones* (P); Grand Junction, alt. 1350 m., 22 May 1895, *Jones* (P); dry hillside, alt. 1760 m., 7 June 1913, *Payson 108* (F, G, M); dry hillside, alt. 1650 m., Naturita, 19 May 1914, *Payson 319* (F, G, I, M); dry rocky hillside, alt. 1650 m., Naturita, 26 May 1914, *Payson 353* (F, G, I, M); shale hills, Ridgeway, 17 June 1924, *Payson & Payson 3833* (G, M); clay to sandy hillside near the Gunnison River, 6 miles west of Delta, Delta Co., 27 Aug. 1937, *Rollins 1975* (G, M).

NEW MEXICO: San Ysidro, 1700 ft., 9 Feb. 1927, *Arsène 19034* (F); Carlsbad, 1 May 1929, *Benke 5022* (F); highlands, Albuquerque, 23 March 1918, *Collins* (G); Pena Blanca, alt. 1600 m., 21 May 1930, *Curtin 108* (F); fields and along railroad tracks, 3 miles north of Escondida, Otero Co., 4 June 1938, *Cutler 1987, 1988, 1990–1997* (M); White Sands, 13 miles w. of Tularosa, Otero Co., 5 June 1938, *Cutler 2004–2015* (M); Jornada del Muerto, 4 miles east of Engle, Sierra Co., 6 June 1938, *Cutler 2049–2053* (M); 7 miles west of Engle, Sierra Co., 7 June 1938, *Cutler 2061, 2062* (M); in fields, 3 miles west of Elephant Butte Dam, Sierra Co., 7 June 1938, *Cutler 2076, 2077, 2079* (M); Farmington, 8 June 1899, *Diehl* (P); on soft "Santa Fe" gravels, San Juan, west side of Rio Grande, Rio Arriba Co., 23 June 1932, *Godwin* (G); Red Valley, on Cuba-San Ysidro road, 7 July 1932, *Goodwin* (G); banks of the Rio Grande River, 19 miles west of Santa Fe, alt. 1650 m., 31 May 1897, *Heller & Heller 3623* (M); Albuquerque, 14 April 1884, *Jones* (P); Rincon, 30 May 1884, *Jones* (P); Organ Pass, 3 May 1930, *Jones* (P); sand dunes west of Alamogordo, 3 May 1930, *Jones 25962, 25964m* (CA, M, P); mesa about two miles east of Albuquerque, alt. 1520 m., 1915, *Kammerer 5* (M); desert hills west of valley, Santa Cruz, Santa Fe Co., 30 June 1936, *Marcelline 1840* (F); sand hills along Cuba Road, near Bloomfield, San Juan Co., 5 July 1929, *Mathias 613, 614* (G, M, P); Santa Fe, June 1874, *Rothrock 80* (F, G); White Sands, Dona Ana Co., 16 July 1897, *Wooton 568* (M); mesa west of the Organ Mts., near Little Mt., Dona Ana Co., 11 May 1902, *Wooton* (NMAM); San Andreas Mts., Jan. 1907, *Wooton* (NMAM); plains 35 miles south of Torrance, alt. 1830 m., 10 Aug. 1909, *Wooton* (NMAM); coll. of 1851-2, ***Wright 1882*** (M) in part.

ARIZONA: sandy and rocky soil of mesa, Lee's Ferry, 6 July 1927, *Cottam 2611* (BYU); rough hills, Fort Whipple, Sept. 1865, *Coues & Palmer 570* (M); on sands and among flat rocks of mesa 5 miles west of Rock Point, Apache Co., 15 June 1938, *Cutler 2198, 2199* (M); sands, 5 miles south of Dennehotso, Apache Co., 15 June 1938, *Cutler 2211–2213, 2215, 2220* (M); bluffs, edge of Painted Desert, 20 Oct. 1928, *Eastwood 15720* (CA); between Tuba City and Tonalea, Coconino Co., 10 Sept. 1938, *Eastwood & Howell* (CA); Bright Angel Trail, Grand Canyon, 24 May 1903, *Grant* (S); rocky soil near Cameron, alt. 1520 m., 7 June 1922, *Hanson A166* (F, M); Holbrook, May 1900, *Hough* (F, G); Yucca, 13 April 1884, *Jones* (P); Pierce's Ferry, 426 m., 19 April 1894, *Jones 5077az* (P); Bonelli's Ferry, 800 ft., 13 April 1903, *Jones* (P); between Holbrook and Snowflake, 19 May 1931, *McKelvey 2287, 2288* (P); desert plain between Flagstaff and Holbrook, 26 May 1935, *Nelson & Nelson 2136* (M); 12 miles northeast of Tuba City, alt. 1600 m., 3 June 1935, *Peebles & Fulton 11874* (CA); Monument Valley, alt. 1600 m., Navajo Co., 4

June 1935, *Peebles & Fulton 11940* (P); Grand Falls of the Little Colorado River, Coconino Co., *Whiting 756* (UNM); open prairie, Flagstaff road, alt. 1600 m., 5 miles west of Winslow, Coconino Co., 22 May 1922, *Wiegand & Upton 2977* (F).

UTAH: dry hills, Green River, alt. 1380 m., Emery Co., 6 June 1927, *Cottam 2077* (BYU); dry sandy hillside, 10 miles north of Moab, Grand Co., 8 May 1935, *Cottam 6843* (BYU); on sand and gravel, Copper Canyon, 7 miles northwest of Oljato Post, San Juan Co., 16 June 1938, *Cutler 2232, 2245, 2261, 2262* (M); sand flat, San Juan Canyon, 2 miles southwest of Mexican Hat, San Juan Co., 20 June 1938, *Cutler 2320* (M); hills above Comb Wash, 8 miles west of Bluff, San Juan Co., 21 June 1938, *Cutler 2327* (M); 10 miles north of Bluff, San Juan Co., 21 June 1938, *Cutler 2342* (M); Snake Creek, San Juan Co., 15 Sept. 1938, *Eastwood & Howell 6704* (CA); dry hillside, red sandstone ledges, north of St. George, 6 April 1935, *Galway* (BYU); Santa Clara Creek, 20 May 1902, *Goodding 677a* (M); west of Green River, between river and quarry ledge, 20 miles south of Vernal, alt. 1430 m., Uintah Co., 19 June 1931, *Graham 6123* (M); flat above quarry ledge, west side of Green River, 20 miles south of Vernal, alt. 1460 m., 20 June 1931, *Graham 6171* (M); on rocky south slope of Leland Bench, just north of Pariette Creek, alt. 1520 m., Uintah Co., 13 May 1935, *Graham 8840* (F, M); shale breaks, east side of Willow Creek, about 5 miles north of mouth of Agency Draw, alt. 1680 m., Uintah Co., 22 May 1935, *Graham 8933* (M); red hill north of St. George, 8 May 1935, *Hall* (BYU); dry sandy hills, Sugar Loaf Mt., St. George, Washington Co., 15 May 1932, *Harrison 301* (BYU, M); dry sandy wash, Dirty-Devil River canyon, alt. 2115 m., Fruita, Wayne Co., 6 April 1934, *Harrison 7398* (BYU, M); near Lower Crossing, 9 July 1883, *Jones* (P); Green River, 9 May 1890, *Jones* (P); red sand, St. George, alt. 900 m., 26 April 1894, *Jones 5110aq* (P); San Rafael Swell, 28 May 1914, *Jones* (S); southern Utah, 1874, *Parry 250* (G, M); shale outcrops near Willow Creek, 22 miles south of Ouray, Uintah Basin, Uintah Co., alt. 1825 m., 16 June 1937, *Rollins 1719* (G); Granite Creek at foot of the Henry Mts., alt. 1520 m., 5 July 1930, *Stanton 331* (BYU); streamside-washes, Crescent Creek, Henry Mts., alt. 1825 m., 15 July 1930, *Stanton 437* (BYU); slopes and mesas west of St. George, 5 May 1919, *Tidestrom 9300* (G, M).

NEVADA: 5 miles northwest of Las Vegas, 10 May 1938, *Barkley 3232* (M); limestone ledges south of Indian Springs, 1250 m., Clark Co., 12 May 1938, *Clokey 7816* (Clo, M); open hillsides, Dry Lake, 17 April 1905, *Goodding 2234a* (G, M, P); red sand, St. Joe, alt. 425 m., 7 April 1894, *Jones 5029af, 5029ag* (P); Moapa, alt. 425 m., 27 April 1904, *Jones* (P); Amargosa Desert, alt. 1215 m., 27 April 1907, *Jones* (P); Moapa, alt. 517 m., 12 May 1905, *Kennedy* (M); rocky hillside 6 miles north of Alamo, Lincoln Co., 1934, *Maguire, Maguire & Maguire 4715* (M); dry rocky slopes, vicinity public camp, Valley of Fire, Clark Co., 5 April 1934, *Maguire, Maguire & Maguire 4722* (M).

MEXICO:

CHIHUAHUA: near Ojo de Vaca, May 1851, *Thurber 304* (G).

Ephedra Torreyana is not as constant throughout its range as *E. trifurca.* Specimens from St. George, Utah, and to the northwest, differ in having the ovulate bracts brighter yellow, more crenulate and more undulate.

4. × **Ephedra arenicola** Cutler,[26] n. hyb.
(= *Ephedra Torreyana* × *Coryi* var. *viscida* Cutler).

Dioecious shrub, 0.25–1 m. high; branches flexuous, terete, up to 3 mm. thick, opposite or whorled at the nodes, angle of divergence about 35 degrees; internodes 2–5.5 cm. long; young stems green, viscid, slightly rough, with numerous small longitudinal furrows, becoming yellowed; bark cinereous, cracked and fissured; terminal buds subuliform; leaves binate or ternate, 2–6 mm. long, obtusely to setaceously tipped from a dorso-median thickening, connate for two-thirds their length at first, later splitting; staminate specimens not seen; ovulate spikes solitary to many at the nodes of the young branches, peduncles 5–50 mm. long, bracts binate, in 4–6 whorls, slightly unguiculate, narrowly elliptic, 3–8 mm. long, 2–5 mm. broad, membranaceous, margins hyaline and erose; seeds paired, one frequently aborted, scabrous, light brown to light yellow, 4–7 mm. long, almost equaling the bracts; tubillus straight to somewhat curved, slightly exserted, the ligulate limb contorted.

SPECIMENS EXAMINED:

ARIZONA: sands, 5 miles south of Dennehotso, Apache Co., 15 June 1938, *Cutler 2217* (G, M, T, US), *2221* (G, M TYPE, T, US).

Among typical *E. Coryi* var. *viscida* growing upon loose sands was found a hybrid with *E. Torreyana* which grows near by on slightly more stable and rocky areas. A comparison of the hybrid with the parent plants follows:

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[26] × **Ephedra arenicola** Cutler, hyb. nov.; frutex dioiceus, 0.25–1 m. altus; ramulis flexuosis, teretibus, usque ad 3 mm. in diametro, ad nodos oppositis vel verticillatis, angulo declinationis circiter 35°; internodiis 2–5.5 cm. longis; caulibus juventate viridibus, viscidis, parce scabris, tenuissime striatis, deinde lutescentibus; rhytidoma cinerea, rimosa, sulcata; gemmis terminalibus subulatis; foliis binis vel ternatis, 2–6 mm. longis, ad apicem obtusis vel pungentibus ex dorso-medio crassificatione, primo ad ⅔ longitudinis connatis, deinde diffisis; spicis stamineis mihi ignotis; spicis femineis solitariis vel multis ad nodos ramulorum novorum, pedunculis 5–50 mm. longis, bracteis oppositis, in verticillis 4–6, parce unguiculatis, anguste ellipticis, 3–8 mm. longis, 2–5 mm. latis, membranaceis, marginibus hyalinis erosis; seminibus binis, quorum uno saepe abortivo, scabriusculis, pallide fulvis vel pallide luteis, 4–7 mm. longis, bracteas subaequantibus; tubillo recto vel parce curvato, leviter exserto, limbo ligulato contorto.

E. Torreyana	*E. arenicola*	*E. Coryi* var. *viscida*
Average internode 2.4 cm.	Average internode 3.5 cm.	Average internode 3.6 cm.
Angle of branch-divergence about 48°.	Angle of branch-divergence about 35°.	Angle of branch-divergence about 28°.
Stem not viscid.	Stem viscid.	Stem viscid.
Leaves ternate.	Leaves binate and ternate.	Leaves binate.
Leaves short, obtuse, persistent.	Leaves long, setaceous, persistent.	Leaves long, setaceous, deciduous.
Ovulate strobilus sessile.	Ovulate strobilus long-peduncled.	Ovulate strobilus long-peduncled.
Bracts ternate.	Bracts binate.	Bracts binate.
Bracts dry, membranaceous, clawed.	Bracts dry, membranaceous, slightly clawed.	Bracts succulent, connate at base.
Seeds light and scabrous.	Seeds light and scabrous.	Seeds dark and smooth.

5. **Ephedra funerea** Coville & Morton in Jour. Wash. Acad. Sci. **25**: 307. 1935.

Erect dioecious shrub, 0.25–1.5 m. high; branches stiff, hard, terete, up to 3.5 mm. thick, solitary or several, usually three, at the nodes, angle of divergence about 60 degrees; internodes 2–6 cm. long; young stems pale gray-green, glaucous, slightly roughened, glandulose, with many small longitudinal furrows, later gray; bark of older stems cinereous, slightly cracked and fissured; terminal buds 1–4 mm. long, acute-conical, not spinose; leaves ternately whorled, 3–6 mm. long, acutely pointed from a dorso-median thickening, at first connate for one-half to two-thirds their total length, later splitting along the margins and spreading slightly, persistent; staminate spikes one, two or three, at the nodes of the young branches, elongate-elliptic, 5–8 mm. long, sessile or borne on very short scaly-bracted peduncles, bracts ternate, in 6–9 whorls, ovate, short-clawed, 3–4 mm. long, 2–3 mm. broad, membranaceous, yellowish, the lower whorl empty; perianth equaling the subtending bracts; staminal column 3–4 mm. long, one-third exserted, with 4–7 sessile or very short-stipitate anthers; ovulate spikes one, two or three, at the nodes of the young branches, lanceolate-obovate, 8–13 mm. long, on short scaly-bracted peduncles, or sessile, bracts ternate, in 6–9 whorls, elongateobovate, broadly clawed, 4–8 mm. long, 3–5 mm. broad, yellow-translucent except for the green thickened central portion, margins slightly dentate; seed solitary, or rarely, two or three, tetragonal, pale green to light brown, smooth to scabrous, 6–9 mm. long, 2–3.5 mm. wide, equaling or barely exceeding the bracts; tubillus straight, exserted, the truncate tip slightly contorted.

Distribution: Death Valley region, California, to Nevada.

SPECIMENS EXAMINED:

CALIFORNIA, DEATH VALLEY REGION: mountain side below Dante's View, 1500 m., 7 April 1935, *Clokey & Templeton 5675, 5676* (Clo, M); Furnace Creek Canyon, alt. 870 m., 16 April 1931, *Coville & Gilman 19* (US); Furnace Creek Canyon, alt. 940 m., 18 April 1931, *Coville & Gilman 108* (US); Boundary Canyon, alt. 1065 m., 24 April 1932, *Coville & Gilman 407–410* (US); Furnace Creek Canyon, near the old town of Ryan, alt. 900 m., 25 April 1932, *Coville & Gilman 444, 445* (US); Furnace Creek Canyon, on the Ryan-Shoshone road, alt. 980 m., 26 April 1932, *Coville & Gilman 447* (US TYPE); Furnace Creek Canyon, junction of the Dante's View road with the Ryan-Shoshone road, alt. 1020 m., 26 April 1932, *Coville & Gilman 448* (US); Warm Springs Canyon, Panamint Mts., about a mile above Warm Springs, alt. 790 m., 30 April 1932, *Coville & Gilman 502, 502A* (US); Furnace Creek Wash, 6 April 1928, *Craig 919* (M); hillside, Ryan, 17–24 March 1924, *Ferris, Scott & Bacigalupi 4036* (S); rocky hillside 1 mile south of Ryan, 16 April 1932, *Hitchcock 12329* (M, P, US); sandy open, 2 miles east of Bradbury Well, Black Mts., 2 April 1928, *Howell 3643* (CA); Funereal Mts., alt. 1200 m., 10 April 1907, *Jones* (P).

NEVADA: gravelly hills, Arden-Mountain Springs, mile 11, alt. 1100 m., Charleston Mts., Clark Co., 22 April 1939, *Clokey 8225* (Clo, M).

6. Ephedra californica Watson in Proc. Am. Acad. **14**: 300. 1879.

Erect or spreading dioecious shrub, 0.3–1 m. high; branches semiflexible to rigid, hard, terete, up to 4 mm. thick, solitary or whorled at the nodes, angle of divergence about 45 degrees; internodes 3–6 cm. long; young stems yellow-green, glaucous, almost smooth, with numerous longitudinal furrows, becoming yellow, then yellow-brown; bark of older stems gray-brown, cracked and irregularly fissured; terminal buds 2–3 mm. long, acute, conical; leaves ternately whorled, 2–6 mm. long, obtusely to acutely tipped from a green-brown dorso-median thickening, connate from one-half to three-fourths their total length; sheath at first membranaceous, later thickened, becoming brown, hard and fibrous, splitting and recurving, subpersistent; staminate spike solitary or several in a whorl at the nodes of the young branches, ovate, 6–7.5 mm. long, short-pedunculate, peduncles many-scaled, bracts ternate, in 8–12 whorls, ovate, slightly united at the base, 2.5–3 mm. long and broad, membranaceous, light orange-yellow except for the hyaline margins, the lower whorls empty; perianth equaling or slightly exceeding the subtending bract; staminal column 3–5 mm. long, one-third exserted, with 3–7 sessile or short-stipitate anthers; ovulate spikes solitary or several in a whorl at the nodes of the young branches, ovate, 7–10 mm. long, very short- and scaly-pedunculate, bracts ternate, in 4–6 whorls, orbicular, very slightly unguiculate, 5–7 mm. long, 5–10 mm. broad, pale yellow-translucent except for the orange- or green-yellow center and basal portions, margins entire; seed solitary, rarely two, nearly globular but indistinctly tetragonal, light to dark brown or chestnut, smooth, 7–9 mm. in diameter, equaling or slightly exceeding the bracts; tubillus straight, barely exserted, with a short ligulate, scarcely contorted limb.

Distribution: southern California and adjacent Arizona, and northern Baja California.

SPECIMENS EXAMINED:

ARIZONA: Kingman-Yucca road, Mohave Co., 26 March 1927, *Braem* (S).

CALIFORNIA: Palm Springs, Riverside Co., 6 April 1903, *Abrams 3204* (CA, P); hills near Tia Juana, 14 May 1903, *Abrams 3489* (G, M, P, S); dry hillsides near Campo, San Diego Co., 24 May 1903, *Abrams 3600* (G, M, P, S); Jacumba, 31 May 1903, *Abrams 3675* in part (S); Palm Springs, 17 April 1926, *Atsalt* (M); granite soil, Mt. Breckenridge, alt. 900 m., Kern Co., 23 April 1932, *Benson 3358* (S); North Island, 7 May 1904, *Chandler 5165* (S); Coronado, alt. 3 m., near San Diego, June 1893, *Cleveland* (S); mouth of Mosaic Canyon, sea level, Death Valley region, 6 April 1935, *Clokey & Templeton 5784* (Clo, M); field at Coronado, 26 Dec. 1908, *Dudley* (S); Caliente Mts., back of Painted Rock, San Luis Obispo Co., June 1927, *Dudley* (CA); near Ozena P. O., Ventura Co., May 1936, *Dudley* (CA); North Coronado, San Diego Co., 7 April 1913, *Eastwood 2570, 2571* (CA); San Felipe Canyon, Colorado Desert, San Diego Co., 14 April 1913, *Eastwood 2782* (CA); Grapevine Creek, Colorado Desert, San Diego Co., 14 April 1913, *Eastwood 2808* (CA); Tia Juana, San Diego Co., 24 April 1913, *Eastwood 2911* (CA); Palm Springs, San Bernardino Co., 30 April 1913, *Eastwood 3082* (CA); Warren's ranch, Campo, San Diego Co., 22 April 1920, *Eastwood 9412, 9413* (CA); Coalinga, Fresno Co., 31 March 1926, *Eastwood 13453* (CA); near Mountain Spring, San Diego Co., 25 April 1932, *Eastwood 18641* (CA); Morongo Valley, San Bernardino Co., 28

May 1932, *Eastwood 18687* (CA); on road from Barstow to Las Vegas, San Bernardino Co., 30 April 1932, *Eastwood 18766* (CA); on road from Barstow to Las Vegas, San Bernardino Co., 30 April 1932, *Eastwood 18798* (CA); Griswold Creek, southeast of Panoche, San Benito Co., 3 May 1937, *Eastwood & Howell 4273, 4274* (CA); Little Panoche Pass, San Benito Co., 19 April 1938, *Eastwood & Howell 5129, 5130* (CA); Jacumba Springs, San Diego Co., 11–16 April 1924, *Eggleston 19706* (CA, P); sand beach which forms the San Diego Bay, opposite town, 4 Nov. 1880, *Engelmann* (M); Whitewater Desert near San Gorgonio Pass, 10 Nov. 1880, *Engelmann* (M); Whitewater Pass, near Palm Springs, March 1927; *Epling* (M); Box Canyon, San Diego Co., 4 April 1932, *Epling & Robison* (M, CA, S); Cuyama Valley, Kern Co., 13 April 1935, *Esau* (CA); head of Cuyama Valley near Kern Co. line, San Luis Obispo Co., 30 March 1935, *Ferris 9140* (CA, S); in wash near Little Panoche Creek, 25 miles from South Dos Palos on the Panoche road, Fresno Co., 7 April 1938, *Ferris 6953* (P, S); Mohave River bed at Daggett, San Bernardino Co., 14 June 1930, *Ferris 8012* (S); pass in Sheep Hole Mts. between Amboy and Dale P. O., San Bernardino Co., 25 April 1932, *Ferris & Bacigalupi 8128* (P, S); wash, west end of Sheep Hole Mts., San Bernardino Co., 24 April 1932, *Fosberg 7951* (M); Round Granite Hill near the Narrows, San Diego Co., 14 Nov. 1935, *Gander 2955* (SD); San Luis Rey Valley, near Rancho San Luis Rey, San Diego Co., 21 Jan. 1937, *Gander 3028* (SD); along Coyote Creek, about 3 miles southeast of Lone Palm, north end of Borego Valley, San Diego Co., 6 March 1935, *Gander 13454* (SD); Chuckawalla Peak, Riverside Co., 2 May 1905, *Hall 5979* (S); Palm Springs, Feb. 1926, *Hart* (CA); near Oil City, Kern Co., 22 April 1905, *Heller 7743* (G, M, S); North Island, San Diego Co., July 1902, *Herre* (P); gravelly soil, San Felipe Wash, half way between Borego Valley and Yaqui Well, western Colorado Desert, San Diego Co., 26 Nov. 1927, *Howell 3247* (CA); sandy soil, east end of Morongo Valley, south Mojave Desert, alt. 90 m., San Bernardino Co., 11 March 1928, *Howell 3409* (CA, S); Barstow, Mohave Desert, alt. 700 m., June 1912, *Jepson 4784* (S); San Diego, 16 March 1882, *Jones 3076* (CA, M, P, S); Palm Spring, alt. 61 m., 10 May 1903, *Jones* (CA, P, S); Bakersfield, alt. 305 m., 23 May 1903, *Jones* (P); Funereal Mts., Death Valley, 10 April 1907, *Jones* (P); Barstow, 18 March 1924, *Jones* (S); Old Woman Mts., eastern Mohave Desert, 13 May 1926, *Jones* (P, S); Big Panoche Pass, 12 miles east of Llanada, San Benito Co., 27 Sept. 1932, *Keck 1833* (CA, S); Cuyana Valley, on Ozena road, 3 miles from Santa Maria-Maricopa road, Santa Barbara Co., 6 May 1933, *Keck 2248* (CA, P, S); south of Bakersfield, March 1925, *McCalla* (CA); Morongo Valley, Riverside Co., 20 March 1936, *MacFadden 14475* (CA); Jacumba-Laguna Mts., alt. 760 m., 9 July 1916, *McGregor 138* (S); near Jacumba, 27 June 1925, *McMinn 1431* (S); Jacumba Hot Springs, near Monument No. 233, 29 May 1894, *Mearns 3332* (G, M, S, US); Mountain Springs, 10 May 1894, *Mearns 3024* (S); vicinity of Monument 258 P, International Boundary, 15 July 1894, *Mearns 3923* (S); Jacumba Hot Springs, 24 May 1894, *Mearns & Schoenfeldt 3260* (CA, S, US); dry sandy wash 10 miles west of 29 Palms, alt. 1060 m., 1 May 1921, *Munz 4548* (P); dry slope near Cottonwood Creek and below Barrett Dam, San Diego Co., 10 May 1924, *Munz 8026* (G, P); sandy wash, Sheephole Mts., southern Mohave Desert, alt. 1060 m., 8 April 1935, *Munz 13805* (P, S); sand wash, Mason Valley, eastern San Diego Co., 30 April 1932, *Munz & Hitchcock 12072, 12073* (M, P); dry rocky mesa between Whitewater and Mission Creek, Colorado Desert, 7 May 1922, *Munz &*

Johnston 5286 (P); mountains near Campo, San Diego Co., April 1889, *Orcutt* (M); southwestern part of the Colorado Desert, San Diego Co., April 1889, *Orcutt* (M); Jamul Valley, southern part of San Diego Co., 25 June 1875, *Palmer 364* (Buf, G TYPE, M); San Diego, southern part of San Diego Co., June 1875, *Palmer 365* (Buf, G, M); Whitewater, March 1881, *Parish & Parish 653, 1153* (M, S); Kern River, 1881, *Parry* (M); sandspit opposite San Diego, 17 March 1882, *Parry* (M); San Diego, April 1882, *Parry* (M); Colorado Desert, 6 Dec. 1881, *Pringle* (M); in sand between desert rocks, Mountain Springs, alt. 790 m., San Diego Co., 2 May 1918, *Spencer 807* (CA, G, P); Coronado Beach, San Diego Co., July 1895, *Stokes* (S); Panoche, April 1930, *Van Dyke* (CA); 29 Palms Canyon, Riverside Co., 18 March 1937, *Winblad* (CA); 4½ miles east of Campo, alt. 760 m., on the road to Jacumba, San Diego Co., 27 May 1931, *Wolf 2146* (P, S); Colorado Desert, March 1881, *Wright 188* (G).

BAJA CALIFORNIA: adobe hillside, Refugio Ranch, alt. 620 m., 28 March 1925, *Ballon* (P); near Enseñada, 9 Sept. 1923, *Eastwood 12358* (CA); dunes and sandy slopes, San Quintin, 5 April 1936, *Epling & Stewart* (S); in wash, Santo Tomas Valley at Santo Tomas, 1 March 1934, *Ferris & Bacigalupi 8502* (P, S, US); Jacumba, 2800 ft., 9 July 1922, *Fisher 37* (US); dry hills southwest of Valle Redondo, 30 May 1932, *Fosberg 8381* (M, P, S); San Jose, Tecate, 27 Nov. 1922, *Gallegos 1355* (US); La Huerta at west base of Hanson-Laguna Mts., alt. 850 m., 2 June 1905, *Goldman 1127* (US); Trinidad Valley, northwest base of San Pedro Martir Mts., alt. 820 m., 4 July 1905, *Goldman 1196* (US); San Matias Pass near Diablito Spring, Valle de Trinidad, 26 March 1936, *Harbison 14851* (S); near Santo Tomas, March 1935, *Harvey 535* (US); hills and bluffs near ocean, Enseñada, 7 April 1921, *Johnston 3020* (CA, G, US); Colnet, 15 April 1925, *Jones* (P); San Quintin Bay, 7 June 1925, *Mason 2058, 2059* (CA, US); San Ysidro Ranch, 2 July 1894, *Mearns 3864* (US); about rocks, 50 miles southeast of Tecate, 13 April 1925, *Munz 9567* (P); dry rocky slope 50 miles southeast of Tecate, alt. 1375 m., 13 May 1925, *Munz 9570* (P); Enseñada, 28 Feb. 1906, *Nelson & Goldman 7548* (US); San Selmo, Encinada district, June 1928, *Nutter-Cox* (CA); San Rafael Valley, 18 March 1885, *Orcutt 1271* (C, M); hillside ten miles south of Enseñada, 24 March 1937, *Purer 7127* (M); mountain pass 15 miles south of El Marmol, 2 Feb. 1929, *Reed 6215* (P); wash 2 miles north of Socorro, 4 Feb. 1929, *Reed 6320* (P); San Ysidro, 28 June 1894, *Schoenfeldt 3805* (US); south slope, 8 miles from Rosario on road to El Marmol, 4 March 1930, *Wiggins 4340* (S); in wash, 10 miles from El Marmol, 6 March 1930, *Wiggins 4379* (S); coastal slope 3–4 kilometers north of Enseñada, 12 Sept. 1929, *Wiggins & Gillespie 4016* (CA, G, M, P, S, US); canyon and adjacent slopes, 15–20 miles east of Enseñada on road to Ojos Negros, 14 Sept. 1929, *Wiggins & Gillespie 4062* (CA, S); juniper-covered slopes in vicinity of Ojos Negros, 15 Sept. 1929, *Wiggins & Gillespie 4085* (CA, G, M, P, S, US).

E. californica may be readily distinguished from the other species with ternate leaf arrangement by the browned and thickened leaves of the older stems.

7. **Ephedra aspera** Engelm. ex Wats. in Proc. Am. Acad. **18**: 157. 1883.

E. peninsularis Johnston in Univ. Calif. Pub. Bot. **7**: 437. 1922.

E. Reedii Cory in Rhodora **40**: 216. 1938.

Erect dioecious shrub, 0.25–1.25 m. high; branches rigid, firm, terete, up to 3 mm. thick, opposite or whorled at the nodes, angle of divergence about 35 degrees; internodes 1–5.5 cm. long; young stems pale to dark green, strongly asperous to smooth and glaucous, with numerous small longitudinal furrows, becoming yellow; bark of older stems cinereous, cracked and fissured; terminal buds obtuse-conical; leaves opposite, very rarely ternately whorled, 1–2.5 mm. long, obtusely tipped from a dorso-median thickening, connate for one-half to seven eighths their length; sheath splitting but the parts subpersistent; staminate spikes paired, rarely solitary or whorled, at the nodes of the young branches, obovate, 4–7 mm. long, sessile, or rarely short-pedunculate, bracts opposite, in 6–10 whorls, obovate, 3 mm. long, 2 mm. broad, membranaceous, yellow to red-brown, the lower whorl empty; perianth slightly exceeding the subtending bract; staminal column 4–5 mm. long, one-third exserted, with 4–6 sessile or very short-stipitate anthers; ovulate spikes paired, occasionally solitary, or whorled at the nodes of the young branches, ovate, 6–10 mm. long, sessile or short- and scaly-pedunculate, bracts opposite, in 5–7 whorls, orbicular, 2–5 mm. long, 2–5 mm. broad, thickened, red-brown, margins membranaceous; seed solitary, in cross-section circular to slightly trigonal, with a minute indentation at the tip between the angles, smooth to slightly roughened, light brown to chestnut, 5–8 mm. long, 2.5–4 mm. broad, exceeding by one-third the bracts; tubillus slightly exserted, almost straight, the limb contorted.

Distribution: southwestern United States and northern Mexico.

SPECIMENS EXAMINED:

TEXAS: rocky hills and dry ravines, Frontera, *Bigelow 2* (G); Fort Bliss, 16 June 1917, *Clemens* (CA, P); Marathon, Brewster Co., 20 April 1928, *Cory 920* (G); Brewster Co., 21 April 1928, *Cory 922* (G); Reagan Canyon, Brewster Co., 22 April 1928, *Cory 924* (G); 55.4 miles south of Alpine, Brewster Co., 13 April 1936, *Cory 18547* (G) type of *E. Reedii;* same locality *18548* (TAM); 9 miles north of Sanderson, Terrell Co., 15 April 1936, *Cory 18736* (G); along railroad, 8 miles west of Sanderson, Terrell Co., 26 May 1938, *Cutler 1846* (M); on talus and summit, Persimmon Gap, Santiago Mts., Brewster Co., 27 May 1938, *Cutler 1851* (M); gravel plain, 8 miles north of Glenn Spring, Brewster Co., 27 May 1938, *Cutler 1863–1868* (M); gravel plain and talus, Fresno Canyon, 25 miles north of Lajitas, Presidio Co., 29 May 1938, *Cutler 1903–1905* (M); gravel plain, 16 miles north of Presidio, Presidio Co., 31 May 1938, *Cutler 1926* (M); slopes and summit, Beach Mts., 8 miles north of Van Horn, Culberson Co., 2–3 June 1938, *Cutler 1958, 1963, 1964, 1966, 1969* (M); canyons near Devil's River, Valverde Co., 13 Sept. 1900, *Eggert* (M); stony hills near Van Horn, 12 May 1901, *Eggert* (M); flats near Van Horn, 12 May 1901, *Eggert* (M); rocky hills near Van Horn, 9 July 1900, *Eggert* (M); alt. 1100 m., southern Brewster Co., 13 July 1927, *Fisher* (P); El Paso, 18 April 1884, *Jones 3726* (CA, F, NMAM, P, S); Indian Hot Springs, 30 April 1930, *Jones 25963* (CA, M, P, S); west of Fort Stockton, 18 April 1931, *Jones 28372* (P); top of Organ Mts., Aug. 1900, *Lemmon 287* (C); Chisos Mts., Aug. 1935, *Marsh 64* (P); Terlingua, Brewster Co., 16 July 1937, *Marsh 103* (F); gravelly mesa north of Chisos Mts., alt. 1065 m., 27 June 1931, *Moore & Steyermark 3258* (CA, G, M, S); Chisos Mts., 28 June 1931, *Mueller 7951* (M); Sierra Blanca, 5 July 1895, *Mulford 272* (M); dry rocky ground near mouth of Pecos River, Valverde Co., 24 April 1928, *Palmer 33475* (M); dry rocky and gravelly ground, plains and foothills of Chisos Mts., 24 May 1928, *Palmer 34145* (M); western Texas, 22 May 1888, *Pringle* (R); vicinity of El Paso, 29 March 1908, *Rose 11634* (G); west base of Lone Mt., Chisos Mts., 21 Feb. 1937, *Sperry 558, 559* (US); El Paso, 188–, *Vasey* (F, I, M); Mt. Franklin, 20 March 1932, *Whitehouse 8340* (CA, F); western Texas, to Frontera, coll. of 1851, *Wright 1883* (M); rocky hills near Frontera, 4 May 1852, *Wright 273?* (G); foothills of Chenate Mts., 9 Sept. 1914, *Young 53* (M).

NEW MEXICO: Pino Blanca, south end of Organ Mts., alt. 1500 m., Dona Ana Co., 11 Sept. 1930, *Fosberg S3960* (P); foot of cliffs near mouth of North Fork, near Three Forks of Rocky Arroyo, Guadalupe Mts., 28 April 1932, *Wilkens 1653* (S); Bishop's Gap, Organ Mts., 4 April 1903, *Wooton* (NMAM).

ARIZONA: Roosevelt Dam, 17 May 1919, *Eastwood 8676* (CA); Coyote Pass on road from Kingman to Oatman, 16 May 1931, *Eastwood 18425* (CA); Yucca, 14 May 1884, *Jones* (P); near Phoenix, 1880, *Lemmon 252* (G, M); Tucson, 1880, *Lemmon* (M); Coyote Pass, between Kingman and Oatman, 16 May 1931, *McKelvey 2253* (P); Sierra Tucson, 27 May 1884, *Pringle 39* (G); Tempe, 1 April 1894, *Toumey* (S).

CALIFORNIA: between Tehachapi and Mojave, 28 June 1908, *Abrams & McGregor 499* (G); eastern base of Coast Range, edge of Colorado Desert, 7 May 1894, *Mearns 2956* (G, M, S); Mountain Springs, San Diego Co., 12 May 1894, *Mearns & Schoenfeldt 3079* (S, US); vicinity of Bonanza King Mine, east slope of Providence Mts., Mojave Desert, alt. 900 m., 21–24 May 1920, *Munz, Johnston & Harwood 4029* (P); Vallecito, June 1882, *Parish & Parish* (M).

MEXICO:

TAMAULIPAS: mountains near Miquihuana, alt. 2100–2700 m., 10 June 1898, *Nelson 4472* (F, G, US).

SAN LUIS POTOSI: Sierra de Guascama, Minas de San Rafael, May 1911, *Purpus 5334* (G, M, US).

COAHUILA: dry valley west of Castanuela, 11 April 1847, *Gregg 414* (M); west of Castanuela, 1848–49, *Gregg 53* in part (G); Sierra Madre, 40 miles south of Saltillo, July 1880, *Palmer 1288* (G, M TYPE, US); Saltillo and vicinity, 15–30 April 1898, *Palmer 69* (G, M, UC, US); Sierra de Parras, March 1905, *Purpus 1102* (F, G, M, P); rocky slopes of El Puerto de San Lazaro, San Lazaro, Municipio de Castaños, 17 June 1936, *Wynd & Mueller 143* (M, US).

ZACATECAS: high ridges, Cedros, June 1908, *Kirkwood 24* (F, G); hills, Cedros, June 1908, *Kirkwood & Lloyd 86* (F, M, US).

CHIHUAHUA: Sta. Eulalia Mts., 4 June 1885, *Pringle 38* (G, M, US); Sta. Eulalia plains, 1885, *Wilkinson 118* (F, US).

BAJA CALIFORNIA: Cedros Island, March–June 1897, *Anthony 281* (F, M, S, UC, US); Magdalena Island, 12 Jan. 1889, *Brandegee* (UC), type of *E. peninsularis;* Calamalli, 25 April 1889, *Brandegee* (UC); Cedros Island, 1 April 1897, *Brandegee* (UC); near Canyon Diablo, 20 miles east, 1 May 1933, *Harvey 588* (US); among loose rocks on an old lava flow, Coronados Island, Gulf of California, 18 May 1921, *Johnston 3757* (CA, UC, US); north of Turtle Bay, 2 June 1925, *Mason 1976, 1977* (CA, F, US); Cedros Island, 3 June 1925, *Mason 2021* (US); north end of Cedros Island, 6 June 1925, *Mason 2021a* (CA, US); Cedros Island, 18–20 March 1889, *Palmer 695* (US); Bay of San Bartolome, 27 April 1889, *Pond* (US); rocky soil near Calmalli, alt. 450 m., Jan.–March 1898, *Purpus 6* (F, S, UC, US); Cape region, near Las Animas, Jan.–March 1901, *Purpus 269* (UC); Cedros Island, 11 March 1911, *Rose 16140* (US); San Bartolome Bay, 14 March 1911, *Rose 16236* (US); 20 miles east of Rosario, 8 Feb. 1935, *Shreve 6842* (F).

Although the type description states: "the seed in pairs," all the specimens on the type sheet have the seeds solitary within the strobilus. The strobili, however, are paired at the nodes, and a note on *Palmer 69,* "the female plant has a few very dry seeds attached," indicates that the term "seed" was used for the entire strobilus.

8. **Ephedra fasciculata** A. Nelson in Am. Jour. Bot. **21**: 573. 1935.

Dioecious shrub, often prostrate, 0.25–1 m. high; branches flexuous, solid, terete, up to 3.5 mm. thick, opposite or whorled at the nodes, angle of divergence from the main stem about 35 degrees; internodes 1–5 cm. long; young stems pale green, very slightly asperous to smooth and glaucous, with small longitudinal furrows, becoming yellowed; bark cinereous, cracked and fissured; terminal buds 1–3 mm. long, obtusely conical; leaves opposite, 1–3 mm. long, obtusely tipped from a barely perceptible dorso-median thickening, connate for two-thirds to three-fourths their length at first, later splitting; sheath hyaline, white, subpersistent; staminate spikes paired or several at the nodes of the young branches, narrowly elliptic, 4–8 mm. long, sessile, bracts opposite, slightly connate, in 4–8 whorls, obovate, 2–3 mm. long, 2 mm. broad, membranaceous, light yellow, the lower whorls empty; perianth exceeding the subtending bract; staminal column 3–9 mm. long, one-fourth to three-fourths exserted, with 6–10 sessile or very short-stipitate anthers; ovulate spikes solitary or several at the nodes of the young branches, elliptic, 6–13 mm. long, sessile or short-pedunculate, bracts opposite, in 4–7 whorls, slightly connate at the base, elliptic, 3–7 mm. long, 2–4 mm. broad, margins hyaline, the back slightly thickened and light brown to green; seed usually solitary, in cross-section almost circular, with numerous longitudinal furrows, light brown, 8–13 mm. long, 3–5 mm. in diameter, one-third to one-half exceeding the bracts; tubillus straight, barely exserted, the ligulate limb bent and slightly contorted.

Distribution: Arizona and southern California.

SPECIMENS EXAMINED:

ARIZONA: Pinal Mts., 18 May 1929, *Eastwood 17314* (CA); Phoenix, alt. 300 m., 6 May 1903, *Jones* (P); Sierra Estrella, 13 April 1931, *Kearney & Peebles 7748, 7759* (P); Tule Tank, Yuma Co., 23 March 1935, *Kearney & Peebles 10897* (P); dry slope, trail from Colorado River to Rampart Cave, Lower Grand Canyon, Mohave Co., 16 June 1937, *Munz 14983* (P); dry sand banks, Phoenix, 2 May 1925, *Nelson 10286* (R TYPE, M, S); rocky slopes, vicinity of Canyon Lake, Apache Trail, 1 May 1935, *Nelson & Nelson 1716* (M).

CALIFORNIA: Kelso, Mohave Desert, alt. 900 m., 2 May 1906, *Jones* (P); canyon near Agua Caliente, April 1882, *Parish & Parish 1238* (G, I, M, S).

9. **Ephedra Clokeyi** Cutler,[27] n. sp.

Erect dioecious shrub, 0.5–1 m. high; branches rigid, solid, terete, up to 3.5 mm. thick, opposite or whorled at the nodes, angle of divergence with the main stem about 40 degrees; internodes 2–5 cm. long; young stems pale green, slightly asperous to smooth and glaucous, with numerous small longitudinal furrows, becoming yellowed; bark cinereous, cracked and fissured; terminal buds 2–3 mm. long, obtuse-conical; leaves opposite, 1–3 mm. long, obtusely tipped from a dorso-median thickening, connate for one-half to seven eighths their length at first, later split; sheath membranaceous, deciduous; staminate spikes paired or numerous at the nodes of the young branches, obovate, 4–7 mm. long, sessile or very short-pedunculate, bracts opposite, slightly connate, in 5–8 whorls, obovate, 2–3 mm. long, 2 mm. broad, membranaceous, light yellow to light brown, the lower whorls empty; perianth exceeding the subtending bract; staminal column 3–6 mm. long, one-fourth to two-thirds exserted, with 6–9 sessile or very short-stipitate anthers; ovulate spikes paired or numerous at the nodes of the young branches, obovate, 6–10 mm. long, sessile or short-pedunculate, bracts opposite, in 5–8 whorls, slightly connate at the base, broadly elliptic, 3–5 mm. long, 2–4 mm. broad, margins hyaline, the back slightly thickened, light brown to green; seed usually solitary, in cross-section almost circular, with numerous longitudinal furrows, light brown, 5–8 mm. long, 2.8–4 mm. broad; tubillus straight, slightly exserted, the ligulate limb bent and contorted.

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[27] **Ephedra Clokeyi** Cutler, sp. nov.; frutex erectus, dioiceus, 0.5–1 m. altus; ramulis rigidis, solidis, teretibus, usque ad 3.5 mm. in diametro, ad nodos oppositis vel verticillatis, angulo declinationis circiter 40°; internodiis 2–5 cm. longis; caulibus juventate pallide viridibus, parce scabris vel laevibus et glaucis, tenuissime striatis, deinde lutescentibus; rhytidoma cinerea, rimosa, sulcata; gemmis terminalibus 2–3 mm. longis, obtuso-conicis; foliis oppositis, 1–3 mm. longis, ad

Distribution: southern Utah, Arizona, Nevada and southern California.

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apicem obtusis ex dorso-medio crassificatione, primo ad ½–⅞ longitudinis connatis, deinde diffisis; vagina membranacea, decidua; spicis stamineis paribus vel multis ad nodos ramulorum novorum, obovatis, 4–7 mm. longis, sessilibus vel brevi-pedunculatis, bracteis oppositis, parce connatis, in 5–8 verticillis, obovatis, 2–3 mm. longis, 2 mm. latis, membranaceis, pallide luteis vel pallide fulvis, bractearum verticillis inferioribus vacuis; perianthis bracteas subtendentes superantibus; columna staminale 3–6 mm. longa, ¼–⅔ exserta, antheris 6–9 sessilibus vel brevissime stipitatis; spicis femineis paribus vel multis ad nodos ramulorum novorum, obovatis, 6–10 mm. longis, sessilibus vel brevi-pedunculatis, bracteis oppositis, in verticillis 5–8, ad basem parce connatis, late ellipticis, 3–5 mm. longis, 2–4 mm. latis, marginibus hyalinis, dorso parce crassatis, pallide fulvis vel viridibus; seminibus plerumque solitariis, in sectione transverse suborbicularibus, sulcis multis longitudinalibus, pallide fulvis, 5–8 mm. longis, 2.8–4 mm. latis; tubillo recto, leviter exserto, limbo ligulato curvato et contorto.

Specimens examined:

Arizona: canyon above Antler, Mohave Co., 8 April 1928, *Braem* (S); Hermit Trail, Grand Canyon, 9 April 1917, *Eastwood 5965* (CA); Hermit Creek, Grand Canyon, 10 April 1917, *Eastwood 6004a, 6017* (CA); Grand Canyon of the Colorado, 11 April 1917, *Eastwood 6032, 6040* (CA); Hermit Trail, 12 April 1917, *Eastwood 6057* (CA); Bright Angel Trail, Grand Canyon, 14 April 1917, *Eastwood 6100* (CA); Roosevelt Dam, 19 April 1917, *Eastwood 6212* (CA); Hieroglyphic Canyon, Salt River Mts., alt. 500 m., Maricopa Co., 24 March 1932, *Gillespie 5529* (P, S, UC); near Oatman, 23 March 1931, *Harrison & Kearney 7586* (F); Chimehuevis, alt. 1400 m., 21 April 1903, *Jones* (P); Hammock, 17 March 1932, *Jones 29008* (M, P); among the lava rocks, Duncan, 22 March 1930, *Nelson 11280a* (G, S).

Utah: St. George, 2 April 1880, *Jones* (M, S); southern Utah, 1874, *Parry 249* (F, G, I, M); valley of the Virgen near St. George, 1874, *Parry 249* (G); southern Utah, 1874, *Parry 251* in part (G, M).

Nevada: gravel, Mica Spring, alt. 1200 m., 14 April 1894, *Jones 5062* (G, M, P, US); Logan, 5 May 1909, *Kennedy 1841* (I, G, S); rocky slopes of small gully, Frenchman Mt., northeast of Las Vegas, 30 May 1933, *Munz 12955* (P).

California: rocky slope and wash, desert, Cottonwood Springs, Riverside Co., 17 April 1935, *Clokey 6510, 6511, 6512* (Clo, M); among rocks, hillside and wash, desert, Cottonwood Springs, Riverside Co., 17 April 1935, *Clokey 6513* (Clo, M type); rocky slopes and wash in desert, Cottonwood Springs, 17 April 1935, *Clokey 6514* (Clo, M); gravelly hills and ravines, Fort Mojave, 25 Feb. 1861, *Cooper* (M); Box Canyon, San Diego Co., April 1932, *Epling & Robison* (CA, M, S); at bridge in Sentenac Canyon, San Diego Co., 7 March 1935, *Gander 138.12* (SD); Borego Palm Canyon, San Diego Co., 14 April 1936, *Gander 1275* (SD); desert along mountains, alt. 300–770 m., Palm Canyon, Riverside Co., 4 April 1917, *Johnston* (P, S); Imperial Valley, 28 Feb. 1924, *Jones* (P); walls of Box Canyon, western Colorado Desert, eastern San Diego Co., 2 April 1932, *Munz & Hitchcock 12047* (F, M, P); dry rocky slopes, vicinity of Corn Springs, Chuckwalla Mts., Colorado Desert, alt. 460 m., 9–12 April 1922, *Munz & Keck 4789* (P); Mountain Springs, 6 April 1914, *Parish 9070* (S); desert sand, Mountain Springs, San Diego Co., 26 March 1917, *Spencer 206* (G, P); on highway 80, Mountain Springs grade, about 1 mile east of Mountain Springs service station, Imperial Co., western edge of Imperial Valley (Colorado Desert), alt. 250–270 m., 1 May 1938, *Whitaker* (M).

This species has been included under *E. nevadensis* Wats. by most botanists but differs from it in having a solitary seed within the strobilus in contrast to the paired seeds of *E. nevadensis*.

10. **Ephedra nevadensis** Watson in Proc. Am. Acad. **14**: 298. 1879.

E. antisyphilitica Wats. in U. S. Geol. Surv. Fortieth Parallel [Bot. King's Exp.] **5**: 329, *pl. 39.* 1871, *not* C. A. Mey.

E. antisyphilitica var. *pedunculata* Watson, *loc. cit.*

E. nevadensis Wats. subvar. *paucibracteata* Stapf in Denkschr. K. Akad. Wiss. Wien **56**^{2}: 83. 1889.

Erect dioecious shrub, 0.25–1.25 m. high; branches rigid to flexuous, solid, terete, up to 4 mm. thick, opposite or whorled at the nodes, angle of branch-divergence about 45 degrees; internodes 1.5–6 cm. long; young stems pale green, glaucous, almost smooth, with small longitudinal furrows, becoming yellow, then gray; bark cinereous, fissured; leaves binate, rarely ternate, 2–4 mm., rarely to 8 mm. long, obtusely tipped from a dorso-median thickening, connate for one-half to two-thirds their length, later splitting and falling off; staminate spikes solitary to several at the nodes of the young branches, elliptic, 4–8 mm. long, sessile to short-pedunculate, bracts opposite, in 5–9 whorls, obovate, 3–4 mm. long, 2–3 mm. broad, membranaceous, yellow to light brown, the lower whorl empty; perianth slightly exceeding the subtending bracts; staminal column 3–5 mm. long, one-quarter to one-half exserted, with 6–9 sessile to short-stipitate anthers; ovulate spikes solitary to several at the nodes of the young branches, suborbicular, 5–11 mm. long, borne on an almost naked 1–50-mm. long peduncle, bracts binate, in 3–5 whorls, suborbicular, connate at the base, 4–8 mm. long, 3–6 mm. broad, herbaceous, light brown to yellow-green, occasionally tinged with pink; seeds paired, rarely solitary, brown, smooth, 6–9 mm. long, 2–4 mm. broad, equaling or exceeding the bracts; tubillus moderately exserted, slightly recurved, barely contorted.

Distribution: Utah, western Arizona, Nevada, Oregon and California.

SPECIMENS EXAMINED:

ARIZONA: Kingman, 14 April 1931, *Eastwood 18007* (CA); Hackberry, 24 May 1884, *Jones* (P); Camp Lowell, 1880, *Lemmon 251* (G).

UTAH: southwest of St. George, alt. 900 m., Washington Co., 3 June 1929, *Cottam 4083* (BYU, P); sandy soil, Santa Clara Bench, alt. 900 m., Washington Co., 24 April 1930, *Cottam 4701* (BYU); dry clay loam, roadside, 6 miles west of Hinckley, alt. 1520 m., Millard Co., 9 May 1935, *Harrison 6305, 6306* (BYU); Santa Clara, 8 April 1880, *Jones* (M); St. George, 2 April 1880, *Jones* (M, S); Frisco, 225 miles southwest of Salt Lake, 22 April 1880, *Jones* (M); Milford, 17 June 1880, *Jones* (P); Milford, 19 June 1880, *Jones* (P); Milford, 22 June 1880, *Jones 1802* in part (CA); gravel, Marysvale, alt. 1820 m., 4 June 1894, *Jones 5388ag* (CA, P); Dutch Mt., alt. 1620 m., Tooele Co., 15 June 1900, *Jones* (P); Vermilion, 4 June 1901, *Jones* (P); Price Valley, alt. 1520 m., 3 July 1903, *Jones* (P); Leamington, alt. 1520 m., 8 May 1911, *Jones* (CA, S); near Salt Lake, *Macbride* (UI); rocky slopes above public camp, Zion National Park, 2 April 1934, *Maguire, Maguire & Maguire 4723* (M); bluffs near Price, alt. 1800 m., 11 June 1900, *Stokes* (S); slopes and mesas west of St. George, 6 May 1919, *Tidestrom 9303* (M, G, US).

NEVADA: gravelly wash, Kyle Canyon, Charleston Mts., 1350 m., Clark Co., 29 April 1938, *Clokey 7465* (Clo, M); near Pyramid Lake, 24 June 1927, *Eastwood 14734, 14736* (CA, P); sandy deserts near Walker River, 7 June 1859, *Engelmann* (M TYPE of *E. antisyphilitica* var. *pedunculata*, G); Columbus, alt. 1520 m., 20 May 1897, *Jones* (P); Good Springs, 1 May 1905, *Jones* (CA); Big Pine, 3 June 1924, *Jones* (P); Pyramid Lake, Washoe Co., 19 May 1905, *Kennedy 999* (M); Pyramid Lake, alt. 1310 m., 1 June 1913, *Kennedy 1988* (I, M, S); west shore of Pyramid Lake, May 1879, *Lemmon* (G, M); shad-scale desert, 17 miles north of Baker, White Pine Co., 16 June 1933, *Maguire & Becraft 2479* (G, M, P); Atlatl Park, Valley of Fire, Clark Co., 6 April 1934, *Maguire, Maguire & Maguire 4717* (M); in desert pavement, 14 miles north of Glendale, Lincoln Co., 6 April 1934, *Maguire, Maguire & Maguire 4719* (M); Corey Canyon, Wassuk Mts., alt. 1850 m., near Hawthorne, 27 June 1919, *Tidestrom 10099* (M, US); Smoky Valley, alt. 1675 m., July 1868, *Watson 1108* in part (G TYPE).

OREGON: very dry slopes of lower Pueblo Mts., above Catlow's ranch, Harney Co., 4 July 1927, *Henderson 8670* (CA).

CALIFORNIA: desert slopes, Jacumba, San Diego Co., 31 May 1903, *Abrams 3676* (G, M, P); Great Falls Canyon, Argus Mts., Mohave Desert, 18 April 1930, *Bailey & Robison* (CA, M); sandy soil, Walker Pass, Piute Mts., alt. 1200 m., Kern Co., 24 April 1932, *Benson 3446* (S); about 60 miles north of Los Angeles, June 1890, *Coquillett* (M, US); Mojave, Kern Co., 13 May 1913, *Eastwood 3220* (CA); between Jacumba and Mountain Springs, San Diego Co., 24 April 1920, *Eastwood 9522* (CA); between Victorville and Lucerne Valley, San Bernardino Co., 29 April 1932, *Eastwood 18716* (CA); on road to Barstow from Las Vegas, San Bernardino Co., 30 April 1932, *Eastwood 18766, 18791* (CA); Acton, Los Angeles Co., June 1902, *Elmer 3599* (M); Palmdale, 24 April 1926, *Epling* (M); in vacant lot, Lancaster, Los Angeles Co., 12 June 1918, *Ferris 909* (S); low desert hills, on shore of Owen's Lake near Gowan, Inyo Co., 11 July 1918, *Ferris 1347* (S); occasional on rocky slopes, eastern base of Hackberry Mt., near Goffs-Lanfair road, alt. 1100 m., San Bernardino Co., 24 April 1928, *Ferris 7283* (S); yucca-juniper forest, 23 miles west of Lancaster in Antelope Valley, Kern Co., 3 May 1929, *Ferris 7702* (P, S); in yucca grove on Tehachapi road, 6 miles from Mojave, 17–24 March 1924, *Ferris, Scott & Bacigalupi 3874* (S); hills near Victorville, alt. 1050 m., San Bernardino Co., May 1905, *Hall 6212* (S); between Lancaster and Victorville, 27 April 1930, *Hart* (CA); Randsburg, Kern Co., 14 April 1905, *Heller 7703* (M); sandy soil, open desert, Mojave Desert, alt. 900 m., 9 miles southeast of Victorville, San Bernardino Co., 11 June 1927, *Howell 2498* (CA); sandy soil, half way between Victorville and Hesperia, Mojave Desert, alt. 900 m., San Bernardino Co., 12 June 1927, *Howell 2529* (CA); Mohave Desert, near Barstow, alt. 800 m., 8 June 1912, *Jepson 4831* (S); hillside, Victorville, 15 May 1920, *Johnston* (P); in sunny, hot, sandy stretches, Deadman Point, Mohave Desert, alt. 900 m., 10 May 1920, *Johnston* (P);

Bishop, Owen's Valley, alt. 1220 m., 15 May 1897, *Jones* (M, P); Victor, alt. 800 m., 17 May 1903, *Jones* (P); west slope of Walker Pass, alt. 1370 m., Kern Co., 5 May 1932, *Munz 12468* (M, P); Mohave River, southeast California, 1 June 1876, *Palmer 524* (G, M, co-types of *E. nevadensis* subvar. *paucibracteata)*; Warren's Well, San Bernardino Mts., alt. 1060 m., 16 June 1894, *Parish 2974* (M); Hesperia, Mojave Desert, 30 May 1918, *Parish 11841* (M, P, S); mountains of the Mojave Desert, March 1882, *Parish & Parish 1368* (M); Cushenberry Springs, Mojave Desert, May 1882, *Parish & Parish 1369* (S); Mojave Desert, May 1882, *Parish & Parish 1369* (G, M); Mohave Desert, 31 May 1882, *Pringle* (M); sandy soil, Argus Mts., alt. 1200–1500 m., April–Sept. 1897, *Purpus 5032* (G, M); Hesperia, April 1892, *Trelease* (M).

The type collection of *E. nevadensis* consists of two species, staminate material of what is now considered *E. nevadensis,* and ovulate material of *E. viridis.* The description by Watson stressed the staminate material and mentioned it first and as Californian specimens of *E. viridis* were cited as being peculiar and perhaps distinct, this is interpreted as leaving the staminate material of Watson's collection as the type. Other material cited in the original description is that of Cooper from Fort Mohave, California *(E. Clokeyi)*; of Gregg from northern Mexico (no number is given but this is probably *E. aspera)*; and a form from New Mexico with no collector or locality given but probably referring to Wright's or Bigelow's collection of *E. aspera* and stated to differ in having very short peduncles and solitary fruits. The form described as *E. Clokeyi* has been included under *E. nevadensis* by most contemporary botanists but is distinct, having only one seed surrounded by membranaceous bracts as opposed to the paired seeds surrounded by herbaceous bracts in *E. nevadensis.*

This species varies greatly, the southern forms mostly smaller and dark-stemmed; the northern forms with large and almost herbaceous, light-colored stems. The very young shoots are frequently marked by a ternate arrangement of some whorls of leaves.

10a. Ephedra nevadensis forma **rosea** Cutler,[28] n. f.

Differs from the species in having roseate bracts, seeds less than 5.5 mm. long.

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[28] **Ephedra nevadensis** forma **rosea** Cutler, f. nov., a specie differt bracteis roseis, seminibus usque ad 5.5 mm. longis.

Distribution: western Nevada and adjacent California.

SPECIMENS EXAMINED:

NEVADA: near Pyramid Lake, 24 June 1927, *Eastwood 14744* (CA TYPE).
CALIFORNIA: Willow Springs, Kern Co., 1 July 1905, *Grinnell 436* (US).

11. **Ephedra viridis** Coville in Contrib. U. S. Nat. Herb. **4**: 220. 1893.

E. nevadensis var. *viridis* (Coville) Jones in Proc. Calif. Acad. II, **5**: 726. 1895.

E. nevadensis subvar. *pluribracteata* Stapf in Denkschr. K. Akad. Wiss. Wien **56**^{2}: 83. 1889.

Erect dioecious shrub, 0.5–1 m. high; branches rigid, firm, terete, up to 3 mm. thick, opposite or numerous at the nodes, angle of divergence about 33 degrees; internodes 1–4.5 cm. long; young stems bright-green to yellow-green, later yellowed; bark of older stems cinereous, cracked and fissured; terminal buds 1–2 mm. long, obtuse-conical; leaves opposite, 1.5–4 mm. long, obtusely to setaceously tipped from a dorsomedian thickening, connate for one-third to three-fourths their length, sheath membranaceous-margined, soon falling to leave the thickened and persistent brown base; staminate spikes paired or numerous at the nodes of the young branches, obovate, 5–7 mm. long, sessile, bracts opposite, barely connate at the base, in 6–10 whorls, ovate, 2–4 mm. long, 2–3 mm. broad, membranaceous, light yellow, slightly reddened, the lower whorl empty; perianth slightly exceeding the subtending bract; staminal column 2–4 mm. long, one-fourth to one-half exserted, with 5–8 sessile or almost sessile anthers; ovulate spikes opposite or several at the nodes of the young branches, obovate, 6–10 mm. long, sessile or on short, scaly peduncles, bracts opposite, in 4–8 whorls, ovate, 4–7 mm. long, 2–4 mm. broad; seeds paired, light brown to brown, trigonal, smooth, 5–8 mm. long, usually exceeding the bracts by one-fourth; tubillus straight or slightly bent, exserted, the ligulate limb slightly contorted and meagerly recurved.

Distribution: western Colorado, Utah, western Arizona, Nevada and California.

Specimens examined:

Colorado: slopes, upper juniper area, Uncompahgre Plateau, west of Delta, 6 June 1909, *Tidestrom 2170* (US).

Arizona: below Beaver Dam divide, Mohave Co., 11 May 1938, *Barkley 3333* (M); edge of Walnut Creek, alt. 2000 m., 1 July 1909, *Burrall* (US); near rim of Grand Canyon, east of Point Hope, 3 April 1918, *Collins* (G); dry flats, Lee's Ferry, alt. 1050 m., Coconino Co., 6 July 1927, *Cottam 2610* (BYU); Bright Angel Trail, Grand Canyon, 26–28 Sept. 1913, *Eastwood 3599* (CA); Grand View Trail, Grand Canyon, 16 June 1916, *Eastwood 5715, 5759* (CA); Hermit Trail, Grand Canyon, 18 June 1916, *Eastwood 5872* (CA); Hermit Creek, 10 April 1917, *Eastwood 6026* (CA); trail to Monument Creek, 11 April 1917, *Eastwood 6033, 6042* (CA); Bright Angel Trail, Grand Canyon, 14 April 1917, *Eastwood 6109* (CA); north rim, Grand Canyon, 22 June 1933, *Eastwood & Howell 934* (CA); mesa between Fredonia and Ryan City, alt. 2000 m., Coconino Co., 8 July 1914, *Eggleston 10191* (P); Bright Angel Trail, Grand Canyon, alt. 1220 m., 31 May 1913, *Goldman 2075* (US); Bright Angel Trail, alt. 2080 m., 19 Aug. 1913, *Goldman 2210* (US); near the hotel, Grand Canyon, 25 April 1905, *Goulding* (S); Grand Canyon, 24 May 1903, *Grant 5644* (CA, M, P, S); canyon 2 miles below Pagumpa, alt. 1220 m., 21 April 1894, *Jones 5089r* (P); mesa below Buckskin Mts., alt. 2120 m., 21 Sept. 1894, *Jones 6063q* (P); Chloride, alt. 1370 m., 14 April 1903, *Jones* (P); Chimehuevis, alt. 980 m., 21 April 1903, *Jones* (P); Peach Springs, 14 June 1929, *Jones* (P); Valentine, Mohave Co., 17 April 1934, *Kearney & Peebles 11107* (US); Walnut Canyon, 19 May 1891, *MacDougall 100* (US); near Canyon Diablo, Coconino Co., 18 May 1931, *McKelvey 2285* (P); Bright Angel Trail, Grand Canyon, 6 May 1917, *Meiere* (CA); edge of Walnut Creek, Coconino National Forest and vicinity, 1 July 1929, *Pearson 225* (US); near Flagstaff, June 1900, *Purpus 7087* (US); Holbrook, 6 May 1899, *Zuck* (M, US).

Utah: west ridge of Virgen River, Zion National Park, 9 May 1938, *Barkley 3115* (M); hillsides, Hunt's ranch, alt. 1800 m., Washington Co., 26 Aug. 1927, *Cottam 1189* (BYU); crevices of lava rock, Veyo, alt. 1750 m., Washington Co., 21 June 1928, *Cottam 3368* (BYU); mountain side, alt. 2000 m., Apex Mine, Washington Co., 4 June 1929, *Cottam 4115* (BYU, P); east of Escalante, alt. 1680 m., 18 June 1929, *Cottam 4380* (BYU); cliff, north of Antelope Springs, alt. 2250 m., Millard Co., 19 April 1930, *Cottam 4630* (BYU, M); foot of Lady Mt. Trail, Zion National Park, 19 June 1928, *Craig 1450* (P); among rocks in canyon, 8 miles west of Castle Dale, Emery Co., 25 June 1938, *Cutler 2373–2375* (M); canyon walls, 5 miles west of Elberta, Juab Co., 26 June 1938, *Cutler 2433–2435* (M); foothills 5 miles northeast of Ephraim, alt. 2000 m., San Pete Co., 20–26 May 1914, *Eggleston 10143* (US); Dry Fork Creek, just above Dry Fork town, alt. 2050 m., Uintah Co., 12 May 1935, *Graham 8813* (M); burned-over north slope of Calamity Ridge, south side of White River, 2 miles southeast of mouth of Wolf Creek, alt. 2000 m., 1 June 1935, *Graham 9073* (M, US); Red Wash, just northwest of mouth of Split Mt. Canyon, above Island Park, alt. 1600 m., Uintah Co., 10 June 1935, *Graham 9147* (M, US); on cliff, Cottonwood Creek Canyon, south of Minnie Maud Creek, alt. 1750 m., Carbon Co., 7 July 1935, *Graham 9521* (M, US); Diamond Valley, 22 April 1919, *Hall 527* (US); near Anderson's ranch, Washington Co., 28 July 1927, *Harris N27134* (M); Ephraim Plateau, 4 Aug. 1927, *Harris C27713* (M); rocky cliffs, Desert Range Experiment Station, alt. 1750 m., Millard Co., 11 May 1935, *Harrison 6382S* (BYU, M); moist north slope, Tintic Mts., east of Eureka, alt. 2120 m., Juab Co., 22 May 1938, *Harrison 8328, 8329* (BYU); rocky sage-brush slope, Ashley Creek Canyon, about 10 miles northwest of Vernal, alt. 1630 m., 14 July 1933, *Hermann 4920* (M); St. George, 2 April 1880, *Jones* (M, P); Frisco, 22 June 1880, *Jones* (CA, M, P); Milford, alt. 1520 m., 22 June 1880, *Jones 1802* (NMAM, S, US); Dutch Mt., 12 June 1891, *Jones* (P); red sand, Belvue, alt. 1100 m., 30 March 1894, *Jones 5001k* (P); gravel, Diamond Valley, alt. 1370 m., 28 April 1894, *Jones 5124* (M, P, US); 10 miles below Kanarra, alt. 1370 m., 12 May 1894, *Jones 5213d* (US); red sand, Johnson, alt. 1600 m., 23 May 1894, *Jones 5289y* (P); red sand, Pahria Canyon, alt. 1600 m., 26 May 1894, *Jones 5297v* (P); gravel, Marvine Laccolite, alt. 1800 m., 23 July 1894, *Jones 5663bf* (P); Monroe, Sevier Co., alt. 1680 m., 24 May 1899, *Jones* (P); Miller Creek, alt. 1800 m., 8 June 1910, *Jones* (P); along Hurricane cliffs, west exposure, 1 mile east of Hurricane, alt. 1020 m., Washington Co., 1 May 1932, *Maguire & Blood 1277* (P); stony ground, Anderson's ranch, St. George, 5 Nov. 1922, *Nelson 9990* (M, R); St. George, collection of 1876, *Parry 251* (G, M, US); Buckskin Mts., Kanab, June 1923, *Rodda* (CA); canyon near Copper Mines, Beaverdam Mts., 6 May 1919, *Tidestrom 9357* (US); dry gumbo hillsides, alt. 1800 m., vicinity of Flaming Gorge, Daggett Co., 31 May 1932, *Williams 463* (CA, P).

NEVADA: 6 miles east of Reno, 13 May 1929, *Canby 173* (P); flat, Kyle Canyon, Charleston Mts., alt. 2100 m., Clark Co., 10 May 1936, *Clokey 7027, 7028* (CA, F, M, S, US); slopes, Mt. Wheeler, alt. 2300 m., White Pine Co., 20 June 1928, *Cottam 3300* (BYU); pass north of Olcott Peak, Charleston Mts., alt. 1700 m., Lincoln Co., 6 March 1891, *Coville & Funston 387* (US); Trail Canyon, White Mts., alt. 2400 m., 14 June 1930, *Duran 501* (CA, M, P, S, US, UW); on road from Reno to Pyramid Lake, 24 June 1927, *Eastwood 14719* (CA); Pyramid Lake, June 1927, *Eastwood 14742* (CA); on road to Pyramid Lake from Reno, June 1927, *Eastwood 14761* (CA, P); Victory Highway, 5 miles east of Sparks, 8 June 1933, *Eastwood & Howell 29* (CA); Constantia, Washoe Co., 15 April 1927, *Haley* (CA); hillsides, alt. 2200 m., Deer Lodge, Lincoln Co., 6 June 1935, *Hall* (BYU); Pyramid Lake, 28 May 1916, *Headley 13* (US); Goldfield, alt. 2000 m., 4 June 1912, *Heller 10411* (S, US); Reno, 16 May 1899, *Hillman* (P); dry hills, Hunter's Canyon, vicinity of Reno, alt. 1350–1500 m., 18 July 1913, *Hitchcock 513½* (US); Austin, 16 June 1882, *Jones* (P); Rhyolite, alt. 1160 m., 11 April 1907, *Jones* (M, P); Round Mt., Nye Co., Aug. 1915, *Phares* (S); Carson City, alt. 1400 m., 3 July 1931, *Rose* (CA); dry lakes, Verdi, May–June 1889, *Sonne 491* (M); canyon, Montezuma Mt., west of Goldfield, alt. 2100 m., 4 April 1919, *Tidestrom 9771* (M, US); slopes of Sweetwater Mts., near Sweetwater, alt. 2280 m., 1 July 1919, *Tidestrom 10200* (US); Smoky Valley, alt. 1675 m., July 1868, *Watson 1108* in part (G); hillside between Silver City and Dayton, Lyon Co., 27 July 1933, *Wiggins 6755* (S).

CALIFORNIA: rocky hills between Rosamund and Mojave, Kern Co., 30 April 1927, *Abrams 11769* (P, S); west side, Walker Pass, alt. 1130 m., Kern Co., 1 May 1927, *Abrams 11920* (P, S); Sespe Creek, near Ten Sycamore Flat, alt. 700–770 m., Ventura Co., 9 June 1908, *Abrams & McGregor 174* (US); near the Frazier Borax Mine, Mt. Pinos, alt. 1600–1900 m., Ventura Co., 12–14 June 1908, *Abrams & McGregor 217* (S); near Mitchell's Canyon, Providence Mts., Mojave Desert, Nov. 1935, *Alpin* (P); granitic soil, arid ridges about 3 miles west of Benton, Mono Co., 6 Nov. 1931, *Applegate 6904* (S); 3–5 miles east of Topaz, Mono Co., 20 May 1915, *Bolton* (CA); Santa Inez River, March 1861, *Brewer 347* (M); 3½ miles west of Leevining, alt. 2400 m., Mono Co., 23 Aug. 1933, *Clausen 797* (S); hillside, Cayama Valley, alt. 1500 m., Ventura Co., 22 May 1935, *Clokey 6516* (Clo, M); just above Crystal Spring, Coso Mts., alt. 1840 m., Inyo Co., 12 June 1891, *Coville & Funston 923* (US TYPE); Cuddy Canyon, Mt. Pinos region, 19 June 1896, *Dudley & Lamb 4609* (P); Janesville, 15 July 1935, *Epling & Robison* (M); Lone Pine Trail, above Little Cottonwood Creek, alt. 2900 m., Inyo Co., 23 June 1923, *Ferris 3741* (S); northwestern slope of Maturango Peak, Argus Mts., Inyo Co., 12 April 1930, *Ferris 7857* (S); above old town of Panamint, Surprise Canyon, Panamint Mts., alt. 2250 m., Inyo Co., 12 June 1930, *Ferris 7955* (M, S); open sandy desert, Hackstaff, Lassen Co., *Ferris & Duthie 4* (S); quartzite slope, Gold Mt., above Baldwin Lake, alt. 2200 m., San Bernardino Co., 19 June 1932, *Fosberg 8500* (M); between Susanville and Leavitt Lake, Lassen Co., 12 May 1930, *Gillespie 9347* (S); Mt. Pinos, Ventura Co., 16 May 1923, *Hart* (CA); desert slope, from Big Bear region, San Bernardino Co., 4 July 1924, *Hart 81* (CA); granite sand, mouth of a canyon about three miles south of Bishop, alt. 1380 m., Inyo Co., 21 May 1906, *Heller 8299* (CA, M, S); sandy slopes, Frazier Mt. Park, Pinos region, Kern Co., 25 May 1928, *Howell 3824* (CA); rocky slopes, south side of Surprise Canyon near Panamint City, Panamint Mts., Inyo Co., alt. 2400 m., 14 June 1928, *Howell 3924* (CA); rocky slope, Kern Canyon, 7 miles above Kernville, alt. 830 m., Kern Co., 13 May 1930, *Howell 5028* (CA); Rose Mine, San Bernardino Mts., alt. 2120 m., 2 Sept. 1921, *Jaeger 1061* (P, S); sunny mountain side, Prairie Fork of San Gabriel River, San Antonio Mts., alt. 1530 m., 23 Aug. 1917, *Johnston 1721* (P, S); rocky ground at foot of hill, Deadman Point, alt. 900 m., 16 May 1920, *Johnston* (P); Needles, 7 May 1884; *Jones* (P); Cactus Flat in Cushenbury Canyon, 12 May 1926, *Jones* (P, S); Jacumba, San Diego Co., 30 July 1923, *Kendall* (P); eight miles up Mt. Whitney Trail from Lone Pine, overlooking Lone Pine Creek, alt. 2250 m., Inyo Co., 9 June 1935, *Kimber* (S); Hot Springs Peak, alt. 1460–2120 m., Lassen Co., July 1913, *Monnet 839* (CA); dry loose slope, Big Rock Creek, San Gabriel Mts., alt. 1300 m., Los Angeles Co., 27 May 1923, *Munz 6876* (P); dry banks, Seymour Creek, Mt. Pinos, alt. 1900 m., 10 June 1923, *Munz 6979* (P); dry slope, Baldwin Lake, San Bernardino Mts., alt. 2120 m., 2 June 1924, *Munz 8188* (P); base of cliffs, 5 miles south of Bridgeport, Mono Co., 22 June 1928, *Munz 11082* (P); among rocks, Eagle Mts., Colorado Desert, alt. 250 m., 13 April 1921, *Munz & Keck 4951* (P); near Bishop, Inyo Co., 29 June 1937, *Noldke* (CA); Rock Spring, Mohave Desert, 14 May 1876, *Palmer 525* (M, CO-TYPE of *E. nevadensis* var. *pluribracteata*); Rose Mine, San Bernardino Mts., alt. 1800 m., San Bernardino Co., 17 June 1894, *Parish 297* (M, US); summit of Pilot Knob, Mojave Desert, 14 May 1922, *Pierson & Johnston 6510* (P); sandy soil, Argus Mts., April–Sept. 1897, *Purpus 5312* (M, US); rocky canyon sides, west slope of Pleasant Canyon, Panamint Range, alt. 800 m., Inyo Co., 30 March 1937, *Train* (S); 4–5 miles south of Tehachipi, alt. 1525 m., Kern Co., 17 June 1928, *Wolf 2210* (CA, P, S); rocky soil, Leevining Canyon, Sierra Nevada, alt. 2300 m., Mono Co., 5 Nov. 1931, *Wolf 2551* (S).

The dark and persistent leaf-bases and the sessile or short-pedunculate ovulate strobili readily distinguish this species from *E. nevadensis*. Specimens of *E. viridis* from high altitudes and from the northern portions of the range have darker leaf-bases and more numerous branches but are not sufficiently distinct to separate.

12. **Ephedra Coryi** Reed in Bull. Torr. Bot. Club **63**: 351, *figs. 1, 2.* 1936.

Erect dioecious shrubs, growing from spreading rhizomes, 0.25–1 m. high; branches terete, up to 2.5 mm. thick, opposite or whorled at the nodes, angle of divergence about 22 degrees; internodes 2–4.5 cm. long; young stems almost herbaceous, bright green, slightly asperous, with numerous small longitudinal furrows, becoming yellow; bark of older stems red-brown, cracked and fissured irregularly; terminal buds 1–3 mm. long, obtusely conical; leaves opposite, acutely tipped from a dorso-median thickening, connate for one-third to three-fourths their length; sheath membranaceous-margined, soon falling to leave the brown, thickened and persistent base; staminate spikes paired or numerous at the nodes of the young branches, obovate, 4–7 mm. long, sessile or short-pedunculate, bracts opposite, slightly connate at the base, in 5–9 whorls, ovate, 2–4 mm. long, 2–3 mm. broad, membranaceous, light yellow, the lower whorl empty; perianth slightly exceeding the subtending bracts; staminal column 2–4 mm. long, one-fourth exserted, with 5–7 sessile or short-stipitate anthers; ovulate spikes opposite or several at the nodes of the young branches, obovate to spherical, 7–15 mm. long, peduncle 3–20 mm. long, with two pairs of bracts, one basal, the other subterminal, bracts opposite, in 3–4 whorls, ovate-acute at first, becoming yellow, fleshy and orbicular at maturity; seeds paired, trigonal, brown to chestnut, smooth, 5–7 mm. long, usually equaling or slightly exceeding the bracts; tubillus straight, slightly exserted, the barely contorted ligulate limb recurved.

Distribution: west-central Texas.

SPECIMENS EXAMINED:

TEXAS: 11¼ miles east of Seminole, Gaines Co., 20 May 1935, *Cory 13711* (US); Boll's ranch, 10 miles southeast of Lubbock, 6 April 1930, *Demaree 7475* (G, M, S); dry prairies near Stanton, Martin Co., 13 June 1900, *Eggert* (M); sandy soil, open ground, Big Spring, Howard Co., 9 July 1917, *Palmer 12491* (CA, M, US); 11¼ miles east of Seminole, Gaines Co., 20 May 1935, *Parks & Cory 11707* (T); Brownfield, *Reed* (US TYPE, not seen); Brownfield, 8 April 1935, *Reed* (TTC); sandy soil, about 12 miles southwest of Lamesa, 22 April 1935, *Reed* (TTC); loose and sandy soil, 1 mile west of Shacktown, 14 June 1934, *Reed 3718* (TTC); sandy, semi-arid soils, level ground, Cedar Lake, about 20 miles southwest of Lamesa, 14 June 1934, *Reed 3719* (TTC); loose and sandy soil, west of Ackerby, 15 June 1934, *Reed 3735* (TTC, US); sandy soil, railroad right-of-way, Meadow, 5 March 1934, *Reed 3897* (TTC); loose sandy soil, between O'Donnell and Lamesa, 16 Sept. 1934, *Reed 4103* (TTC); Meadow, 4 July 1935, *Reed 4200* (TTC); between Wellman and Meadow, 29 July 1934, *Reed 4354* (TTC).

12a. E. Coryi var. **viscida** Cutler,[29] n. var.

Differs from the species in having the aerial stems frequently branching, the young stems viscid, and the bracts not fleshy.

Distribution: southwestern Colorado, northwestern New Mexico, and adjacent Utah and Arizona.

SPECIMENS EXAMINED:

COLORADO: Deer Run, Gunnison watershed, alt. 1430 m., coll. of 1901, *Baker 921* (P); plains south of Mancos, 8 July 1898, *Baker, Earle & Tracy 397* (M, P); San Juan Valley, July 1875, *Brandegee 7754* (M); dry situations, Church Rock Canyon, 17 June 1927, *Cottam 2319* (BYU); Gunnison Mesa, Grand Junction, 15 May 1916, *Eastwood 5121* (CA); Book Cliff road, Grand Junction, 18 May 1916, *Eastwood 5190, 5191* (CA, S); clay, Grand Junction, alt. 1360 m., 21 June 1894, *Jones 5476v* (P); foothills and mountains, Mesa Co., summer of 1893, *Long* (G); Spruce Canyon, near camp ground, Mesa Verde National Park, 8 July 1929, *Mathias 645* (M, P); dry hills, alt. 1650 m., 28 May 1914, *Payson 367* (M, S); Glenwood Springs, 1 Sept. 1917, *Payson 1199* (M); talus slope of sand and shale, Colorado National Monument, 10 miles southwest of Fruita, alt. 1830 m., 13 Aug. 1937, *Rollins 1931* (CA, M); dry, rocky foothills, Paradox, alt. 1610 m., Montrose Co., 22 June 1912, *Walker 161* (M); dry canyon slope, Norwood Hill, alt. 2200 m., San Miguel Co., 20 Aug. 1912, *Walker 511* (M, P).

NEW MEXICO: Frijoles Canyon, alt. 2000 m., vicinity of Santa Fe, 4 June 1936, *Arsène 22799* (US); along Cuba road, near Bloomfield, San Juan Co., 4 July 1929, *Mathias 611, 612* (M, P); dry hills, alt. 1550–1650 m., vicinity of Farmington, San Juan Co., 17 July 1911, *Standley 6938* (US); mountain side, Bandelier National Monument, 24 June 1935, *Studhalter, Cox & Langford 52449* (US).

ARIZONA: desert near Tuba, 15–31 July 1920, *Clute 100* (M); Montezuma Castle National Monument, Yavapai Co., 20 May 1937, *Cutler 1115* (M, UW); sandy desert, 15 miles east of Tuba City, Coconino Co., 21 May 1937, *Cutler 1147* (M, UW); Monument Canyon, 7 miles southeast of Chinle, Apache Co., 12 June 1938, *Cutler 2143–2148* (M); Canyon de Chelly, near Chinle, Apache Co., 13 June 1938, *Cutler 2156* (M); loose sand, 4 miles south of Round Rock, Apache Co., 14 June

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[29] **E. Coryi** var. **viscida** Cutler, var. nov., a specie differt caulibus ligneis aeriis saepe ramosis, juventate viscidis, bracteis non valde carnosis et non saepe esculentis.

1938, *Cutler 2161–2165, 2169, 2170* (M); sands of mesa, 5 miles west of Rock Point, Apache Co., 15 June 1938, *Cutler 2174, 2183, 2200* (M); loose sand, 10 miles west of Rock Point, 15 June 1938, *Cutler 2209* (M TYPE), *2210* (M); loose sand, 5 miles south of Dennehotso, Apache Co., 15 June 1938, *Cutler 2214, 2216, 2218, 2219* (M); between Tuba City and Tonalea, Coconino Co., 10 Sept. 1938, *Eastwood & Howell* (CA); between Kayenta and Monument Valley, Navajo Co., 14 Sept. 1938, *Eastwood & Howell* (CA); near Canyon Diablo, Coconino Co., 18 May 1931, *McKelvey 2284* (P); steep, rocky, brushy slopes near Indian Gardens, Oak Creek Canyon, 23 May 1935, *Nelson & Nelson 2087* (M); near Ganado, 17 May 1934, *Peebles 9352* (US); sandstone bluff, edge of marsh, alt. 1520 m., near Tuba City, Navajo Co., 2 June 1935, *Peebles & Fulton 11857* (US); 14 miles north of Kayenta, alt. 1600 m., Navajo Co., 4 June 1935, *Peebles & Fulton 11935* (US); gorge of the Little Colorado River, alt. 1650 m., Coconino Co., 8 June 1937, *Peebles & Smith 13340* (US); in sand, 5 miles southeast of Tuba City, alt. 1550 m., Coconino Co., 8 June 1937, *Peebles & Smith 13361* (US); Oraibi, alt. 2000 m., 29 June 1935, *Whiting 756/732* (UNM); Navajo Springs, 24 July 1892, *Wooton* (NNAM).

UTAH: cliffs, Moab, 7 June 1927, *Cottam 2138* (BYU); sandy bluff, alt. 1800 m., Blanding, San Juan Co., 1 July 1927, *Cottam 2502, 2518* (BYU); dry flat, Monument Valley, alt. 1680 m., 2 July 1927, *Cottam 2566* (BYU); hills above Comb Wash, 8 miles west of Bluff, San Juan Co., 21 June 1936, *Cutler 2328* (M); loose sand, 4 miles north of Bluff, San Juan Co., 21 June 1938, *Cutler 2340, 2341* (M); 6 miles northwest of La Sal Junction, San Juan Co., 23 June 1938, *Cutler 2365* (M); under an overhanging cliff of Augusta Natural Bridge, San Juan Co., 7 May 1933, *Harrison 5913* (M); canyon bottom, Augusta Natural Bridge, San Juan Co., 7 May 1933, *Harrison 5914* (M); Moab, 30 Aug. 1891, *Jones* (P); 1½ miles east of Armstrong Canyon, National Bridges Monument, alt. 1750 m., San Juan Co., 22 June 1932, *Maguire & Redd 1631* (M); western slope of La Sal Mts., near Little Springs, alt. 2000–2200 m., 5–6 July 1911, *Rydberg & Garrett 8571* (US).

This variety is dominant over extensive stretches of sandy desert in the Navajo Indian Reservation and near-by regions and forms large hummocks. In the north and at high altitudes it is difficult to distinguish vegetative material from *E. viridis*, but the long peduncle of the ovulate strobili and the usual viscid stems distinguish other specimens. A probable hybrid of this variety and *E. Torreyana* has been given the binomial *Ephedra arenicola* earlier in this paper.

13. **Ephedra antisyphilitica** Berland. ex C. A. Mey. in Mém. Acad. Imp. Sci. St. Petersburg, VI, Sci. Nat. **5**: 291. 1846.

E. occidentalis Torr. ex Parl. in DC., Prodr. **16**^{2}: 354. 1868.

E. texana Reed in Bull. Torr. Bot. Club **62**: 43. 1935.

Erect or spreading dioecious shrub, 0.25–1 m. high; branches stiff, hard, terete, up to 4 mm. thick, alternate or whorled at the nodes, angle of divergence about 48 degrees; internodes 2–5 cm. long; young stems green, glaucous, almost smooth, with many small longitudinal furrows, becoming yellow-green, then gray-green; bark of older stems cinereous, slightly cracked and fissured; terminal buds 2–3 mm. long, obtusely pointed; leaves binate, 1–3 mm. long, obtusely tipped from a dorsomedian herbaceous thickening, connate for two-thirds to nine-tenths their total length; sheath membranaceous, later splitting and falling; staminate spikes solitary or paired at the nodes of the young branches, lanceolate-elliptic, 5–8 mm. long, almost sessile, 5–8 pairs of bracts, obovate, one-eighth connate at the base, 2–3.5 mm. long, 2–3 mm. broad, slightly thickened, margins membranaceous, pale green to reddish, the lower pair empty; perianth slightly exceeding the subtending bract; staminal column 4–5 mm. long, one-half exserted, with 4–6 sessile or very short-stipitate anthers; ovulate spikes solitary or paired at the nodes of the young branches, rarely several at a node, elliptic, 6–11 mm. long, nearly sessile, 4–6 pairs of bracts, ovate, one-eighth to seven-eighths connate, the inner pairs becoming fleshy, red, succulent when ripe; seed solitary, trigonal or occasionally tetragonal, light brown to chestnut, smooth, 6–9 mm. long, 2–3.5 mm. broad, conspicuously exserted; tubillus straight, slightly exserted, ligulate limb slightly contorted.

Distribution: southwestern Oklahoma, and west-central Texas to northeastern Mexico.

SPECIMENS EXAMINED:

OKLAHOMA: along the Red River, Harman Co., 16 Dec. 1933, *Goodman & Barkley* (F, G, M).

TEXAS: desert plains, Nolan Co., 3 Aug. 1934, *Barkley* (M); Rio Frio, "entre Laredo et Dejar," Feb. 1828, *Berlandier 1590* [*=320*] (C, M, CO-TYPES); Big Springs, 20–23 May 1899, *Bray 394* (US); San Antonio, Bexar Co., 15 April 1911, *Clemens & Clemens 380* (CA, M, P); 9 miles northwest of Edinburg, Hidalgo Co., 30 Dec. 1933, *Clover 1593* (CA); 3 miles east of San Angelo, Tom Green Co., 28 April 1931, *Cory* (M); 15 miles north of Eldorado, Schleicher Co., 29 April 1931, *Cory* (US); Croton Camp, Matador Ranch, Dickens Co., 15 June 1904, *Coville 1871* (US); Texas Agricultural Experiment Station number 14, west of Rock Springs, Edwards Co., 24 May 1938, *Cutler 1815, 1816* (M); pasture 12 miles south of Sonora, Sutton Co., 24 May 1938, *Cutler 1817* (M); ungrazed field, 10 miles south of Sonora, Sutton Co., 24 May 1938, *Cutler 1819, 1820* (M); 12 miles southwest of Sonora, Sutton Co., 24 May 1938, *Cutler 1822* (M); 14 miles south of Juno, Val Verde Co., 24 May 1938, *Cutler 1830* (M); pastures, 7 miles west of Comstock, Val Verde Co., 24 May 1938, *Cutler 1831* (M); along railroad 4 miles w. of Shumla, Val Verde Co., 24 May 1938, *Cutler 1833* (M); pasture ½ mile west of Dryden, Terrell Co., 24 May 1938, *Cutler 1837–1839* (M); gravel plain 1 mile west of Sanderson, Terrell Co., 26 May 1938, *Cutler 1840–1842* (M); along railroad 8 miles west of Sanderson, Terrell Co., 26 May 1938, *Cutler 1845* (M); rocky hills near Stanton, Martin Co., 13 June 1900, *Eggert* (M); hills and valleys, Laredo, 18 Feb. 1919, *Hanson 344* (G, M, UW); Nibo Mt., Gillespie Co., *Jermy 154* (M, US); Experiment Station, Sonora, 21 April 1931, *Jones 28371* (CA, M, P, S); Laredo, 24 March 1932, *Jones 29009* (M); below Laredo, 26 March 1932, *Jones* (P); between Uvalde and Del Rio, 18 April 1931, *McKelvey 1895* (P); between the Frio and the Nueces rivers, on the road to Laredo, 27–28 Jan. 1880, *Palmer 1289, 1292* (M); dry limestone hills, Concan, Uvalde Co., 14 June 1916, *Palmer 10190* (US, S); dry limestone hills, San Angelo, Tom Green Co., 28 June 1916, *Palmer 10309* (M, S, US); dry calcareous hillsides, Telegraph, Kimble Co., 8 Oct. 1916, *Palmer 10951* (M, US); sandstone hills, Campbelton, Atascosa Co., 9 March 1917, *Palmer 11238* (CA, M, UC, US); dry rocky hills, Brownwood, Brown Co., 18 Oct. 1917, *Palmer 13028* (CA, M, US); dry limestone ledges near Brownwood, Brown Co., 31 Oct. 1924, *Palmer 26783* (M); along caprock escarpment and the broken country to the eastward, Buffalo Springs, Lubbock, 15 April 1934, *Reed 3628* (US); caliche soil along escarpment, Buffalo Springs, Lubbock, *Reed 3946* (R); Buffalo Springs, Lubbock, 30 Sept. 1934, *Reed 4113* (R); Johnson's ranch, Yellow House Canyon, Lubbock, 2 March 1935, *Reed 4143* (R); Rocky Bluffs, Brown Co., April 1882, *Reverchon 925* (F, M, US); vicinity of Langtry, 27 March 1908, *Rose 11621* (US); pasture, La Salle Co., 4 May 1919, *Schulz 90* (US); near Paint Rock, Concho Co., 27 April 1931, *Terry V21* (P); near Eagle Pass, Maverick Co., 6 Aug. 1925, *Tharp 3334* (US); San Antonio, *Wilkinson 113* (M).

MEXICO:

SAN LUIS POTOSI: region of San Luis Potosi, 1878, *Parry & Palmer 854* (M).

NUEVO LEON: mountains near Icamole, 3 Feb. 1907, *Safford 1251* (M).

Ephedra antisyphilitica and *E. pedunculata* have been regarded frequently as a single species, yet they are very distinct and no true intergrading forms have been found. The former species rarely has a pair of seeds but never assumes the clambering habit or attains the long stipitation of the anthers that characterizes *E. pedunculata*. The latter appears frequently to have a habit of erect growth when it has been repeatedly grazed over by stock.

13a. E. antisyphilitica var. **brachycarpa** Cory in Rhodora **40**: 218. 1938.

Like the species except the ovulate spikes are shorter, less than 6 mm. long, and broader; seed broader, about 3 mm. wide, definitely trigonous, included.

Distribution: known only from Kent and Bexar counties, Texas.

SPECIMENS EXAMINED:

TEXAS: eastern Bexar Co., 25 March 1935, *Parks 12175* (US TYPE, not seen); eastern Bexar Co., 25 March 1935, *Parks, 12176, 12177* (T).

14. Ephedra compacta Rose in Contrib. U. S. Nat. Herb. **12**: 261. 1909.

Erect or spreading, compact dioecious shrub, 0.3–0.5 m. high; branches stiff, hard, almost terete, up to 2.5 mm. thick, opposite or whorled at the nodes, angle of divergence about 37°; internodes 0.5–3 cm. long; young stems gray-green, glaucous, with several longitudinal furrows, becoming distinctly gray; bark of older stems gray-brown, lightly fissured and cracked; terminal buds about 1.5 mm. long, conical; leaves opposite, 1.5–3 mm. long, obtusely pointed, connate for one-half to seven-eighths their length; sheath chartaceous, red-brown in earlier stages, later gray and divided, subpersistent; staminate spikes not seen; ovulate spikes solitary or paired at the nodes of the young branches, ovate, 4–8 mm. long, almost sessile, 3–5 pairs bracts, broadly ovate, 4–5 mm. long, 3–5 mm. broad, one-eighth to three-fourths connate when mature, the inner pairs red and succulent; seeds paired, light brown to chestnut, almost smooth, 3.5–5.5 mm. long, 2–3 mm. broad, slightly exceeding the bracts; tubillus straight, barely exserted, the tip truncate.

Distribution: east-central Mexico, Coahuila to Oaxaca.

SPECIMENS EXAMINED:

MEXICO:

OAXACA: Las Naranjas, Aug. 1908, *Purpus 3054* (F, M, US).

PUEBLA: Esperanza, Sept. 1911, *Purpus 5698* (F, M, US); near Tehuacan, 1–2 Aug. 1901, *Rose & Hay 5835* (US); near El Riego, Tehuacan, 2 Sept. 1905, *Rose & Hay 10023* (US); hills west of town, near Tehuacan, 2 Sept. 1906, *Rose & Rose 11274* (US TYPE); near Tehuacan, 30 Aug.–8 Sept. 1905, *Rose, Painter & Rose 10023* (US).

SAN LUIS POTOSI: Charcas, July–Aug. 1934, *Lundell 5165* (CA, F, US).

COAHUILA: rocky soil, battlefield near Buena Vista, 19 May 1848, *Gregg 53* in part (G, M).

15. Ephedra pedunculata Engelm. ex Wats. in Proc. Am. Acad. **18**: 157. 1883.

Vine-like shrub, trailing on ground or clambering over bushes and trees, often to a height of 6–7 m., dioecious; branches lax, firm, terete, up to 3 mm. thick, alternate, or rarely, whorled at the nodes, angle of divergence about 52 degrees, internodes 1–7 cm. long; young stems gray-green, glaucous, almost smooth, with several moderately deep longitudinal furrows, becoming more green, then yellow-green; bark of older stems cinereous, slightly cracked and fissured; terminal buds 1–3 mm. long, attenuated; leaves binate, 1–3 mm. long, obtusely tipped from a dorso-median herbaceous thickening, connate from two-thirds to nine-tenths their total length; sheath membranaceous, later splitting; staminate spikes solitary or paired at the nodes of the young branches, lanceolate-elliptic, 4–8 mm. long, peduncles 0–12 mm. long, 6–12 pairs of bracts, obovate, free or one-eighth connate at the base, 1.5–3.5 mm. long, 1.5–3 mm. broad, slightly thickened, margins membranaceous, pale yellow to reddish, the lower pair empty; perianth slightly exceeding the subtending bract; staminal column 3–5 mm. long, one-half exserted, with 4–6 definitely stipitate anthers; ovulate spikes solitary or paired at the nodes of the young branches, rarely several at a node, elliptic, 6–10 mm. long, peduncles 1–20 mm. long, 3–6 pairs of bracts, ovate, one-eighth to seven-eighths connate, the inner pairs becoming fleshy, red, succulent when ripe; seeds paired, trigonal, light-brown to chestnut, smooth, 4–9 mm. long, 2–3.5 mm. broad, conspicuously exserted; tubillus slightly kinked, somewhat exserted, limb contorted.

Distribution: southwestern Texas east of the Pecos River, to San Luis Potosi, Mexico.

SPECIMENS EXAMINED:

TEXAS: between Barrocetes ranch and Aquilares, Zapata Co., 19 Dec. 1933, *Clover 1584* (CA); Ranch Experiment Station, Edwards Co., 9 Sept. 1931, *Cory* (M); climbing on fence and on spiny shrubs, 12 miles south-southwest of Sonora, Sutton Co., 24 May 1938, *Cutler 1821* (M); climbing over trees and shrubs, 14 miles south of Juno, Val Verde Co., 24 May 1938, *Cutler 1827* (M); 1890, *Nealley 258* (F, R); Uvalde, 90 miles northwest of San Antonio, 1880, *Palmer 1291* (M TYPE, US); Rio Frio, Oct. 1851, *Parry* (M); Barrens, Brown Co., April 1882, *Reverchon* (F); Uvalde Co., June 1846, *Reverchon 1658* (M).

MEXICO:

TAMAULIPAS: La Sardiña, Sierra de San Carlos, alt. 650 m., 14 Aug. 1930, *Bartlett 1095* (US).

SAN LUIS POTOSI: en route from San Luis Potosi to Tampico, Dec. 1878–Feb. 1879, *Palmer* (I); San Luis Potosi and vicinity, July–Aug. 1898, *Palmer 702* (US); San Luis Potosi, 1878, *Parry & Palmer 855* (F, I, M, US); San Luis Potosi, Aug. 1879, *Schaffner 279* (CA, F, P, US).

NUEVO LEON: Lampazos, 26 June, *Edwards* (F).

COAHUILA: States of Coahuila and Nuevo Leon, July 1880, *Palmer 1289* (I, M, US); Juarez, 100 miles north of Monclova, Sept. 1880, *Palmer 1290* (I, M, US); Saltillo, 1898, *Palmer 283* (F, M, US).

ZACATECAS: plains, Cedros, June 1908, *Lloyd 75, 214* (M, US); near Concepcion del Oro, 22 Nov. 1902, *Palmer 372* (US).

CHIHUAHUA: Bachimba Canyon, 15 April 1885, *Pringle 134* (F, US); Sta. Eulalia plains, 13 April 1885, *Wilkinson 117* (US) in part.

DURANGO: dry valley between Mapimi and Guajuguilla, 18 April 1867, *Gregg 484* (M); Durango, April–Nov. 1896, *Palmer 149* (F, M, US).

LIST OF EXSICCATAE

The distribution numbers are in *italics*. Unnumbered collections are indicated by a dash. The numbers in parentheses are the species numbers used in this monograph.

Abrams, Le Roy. *3204, 3489, 3600, 3676* in part (6); *3676* in part (10); *11769, 11920* (11).
Abrams, L. R., & E. A. McGregor. *499* (7); *174, 217* (11).
Allen, Eva. *177* (1).
Anthony, A. W. *281* (7).
Aplin, J. A. — (11).
Applegate, E. I. *6904* (11).
Arsène, Bro. G. *19034* (3); *22799* (12a).
Atsalt, S. (6).
Bacigalupi, Rimo, see—R. S. Ferris.
Bailey, Harold, & W. Robison. — (10).
Baker, Carl F. *921* in part (6); *921* in part (12a).
Baker, C. F., F. S. Earle, & S. M. Tracy. *397* (12a).
Ballon, L. — (6).
Ballou, F. O. — (1).
Barkley, Fred A. *3232* (3); *3115, 3333* (11); — (13); see—G. J. Goodman.
Barlow, Bronson. — (1).
Bartlett, Harley Harris. *1095* (15).
Bartram, Edwin B. *16* (1).
Becraft, R. J., see—B. Maguire.
Benke, *5022* (3).
Benson, Lyman. *3358* (6); *3446* (10).
Berlandier, J. L. [*320*] *1590* (13).
Bigelow, J. M. *3* (1); *4* (3); *2* (7).
Blood, H. L., see—B. Maguire.
Bolton, A. L. — (11).
Braem, Selma. — (6); — (9).
Bray, William. *394* (13).
Brandegee, T. S. — (7); *7754* (12a).
Brewer, William H. *347* (11).
Burrall, H. D. — (11).
Campbell, Mrs. R. W. — (1).
Canby, W. *173* (11).
Carlson, John I. — (1).
Chandler, H. P. *5165* (6).
Clausen, J. *797* (11).
Clemens, Mr. & Mrs. Joseph. *380* (13).
Clemens, Mrs. Joseph. — (7).
Cleveland, D. — (6).
Clokey, Ira W. *7816* (3); *8225* (5); *6510-6514* (9); *7465* (10); *6516, 7127, 7027, 7028* (11).
Clokey, I. W., & Bonnie C. Templeton. *5675, 5676* (5); *5784* (6).

Clover, Elzada U. *1593* (13); *1584* (15).
Clute, Willard N. *100* (12a).
Collins, John Franklin. — (3); — (11).
Collom, Mrs. Rose E. *341* (1).
Cooper, Juan. — (9).
Coquillett, D. W. — (10).
Cory, Victor L. *2829* (3); *920, 922, 924, 18547, 18548, 18736* (7); *13711* (12); — (13); — (15); see—H. B. Parks.
Cottam, W. P. *2077, 2611, 6843* (3); *4083, 4701* (10); *1189, 2610, 3300, 3368, 4115, 4380, 4630* (11); *2138, 2319, 2502, 2518, 2566* (12a).
Coues, Elliott, & Edward Palmer. *570* (3).
Coville, Frederick Vernon. *1871* (13).
Coville, F. V., & F. Funston. *387, 923* (11).
Coville, F. V., & M. F. Gilman. *19, 108, 407–410, 444, 445, 447, 448, 502, 502a* (5).
Cox, M., see—R. A. Studhalter.
Craig, T. *919* (5); *1450* (11).
Curtin. — *108* (3).
Cutler, Hugh Carson. *622, 1852-1859, 1877, 1879, 1881, 1920, 1942, 1943, 1952, 1980-1984, 2019, 2068-2074* (1); *2020, 2021, 2075, 2078* (2); *1987, 1988, 1990-1997, 2004-2015, 2049-2053, 2061-2062, 2076, 2077, 2079, 2198, 2199, 2211-2213, 2215, 2220, 2232, 2245, 2261, 2262, 2320, 2327, 2342,* (3); *2217, 2221* (4); *1846, 1851, 1863-1868, 1903-1905, 1926, 1958, 1963, 1964, 1966, 1969* (7); *2373-2375, 2433-2435* (11); *1115, 1147, 2143-2148, 2156, 2161-2165, 2169, 2170, 2174, 2183, 2200, 2209, 2210, 2214, 2216, 2218, 2219, 2328, 2340, 2341, 2365* (12a); *1815-1817, 1819, 1820, 1822, 1830, 1831, 1833, 1837-1839, 1840-1842, 1845* (13); *1821, 1827* (15).
Demaree, Delsie. *7475* (12).
Detwiler, S. B. *21* (1).
Diehl, I. E. — (3).
Dudley, W. R. — (6).
Dudley, W. R., & F. H. Lamb. *4609* (11).
Duran, Victor. *501* (11).
Duthie, R., see—R. S. Ferris.
Earle, F. S. see—C. F. Baker; see—S. M. Tracy.
Eastwood, Alice. *6348, 8115, 8192, 8193, 8624, 16608, 16808, 16950, 17169, 17447, 17526, 17805, 17811* (1); *15720,* — (3); *2570, 2571, 2782, 2808, 2911, 3082, 9412, 9413, 12358, 13453, 18641, 18687, 18766, 18798* (6); *8676, 18425* (7); *17314* (8); *5965, 6004a, 6017, 6032, 6040, 6057, 6100, 6212* (9); *3220, 9522, 14734, 14736, 18007, 18716, 18768, 18791* (10); *14744* (10a); *3599, 5715, 5759, 5872, 6026, 6033, 6042, 6109, 14719, 14742, 14761* (11); *5121, 5190, 5191* (12a).
Eastwood, A., & J. T. Howell. *6704,* — (3); *4273, 4274, 5129, 5130* (6); *29, 934* (11); — (12a).
Edwards, Mary T. — (15).
Eggert, Henry. — (1); — (7); — (12); — (13).
Eggleston, Willard W. *16269, 16508* (1); *19706* (6); *10143, 10191* (11).
Ellis, J. H., & O. S. Ledman. — (1).
Elmer, A. D. E. *3599* (10).
Engelmann, George. — (1); — (6).
Engelmann, Henry. — (10).
Epling, Carl Clawson. — (6); — (10).
Epling, C. C., & W. Robison. — (6); — (9); — (11).
Epling, C. C., & W. Stewart. — (6).
Esau, Katherine. — (6).
Ferris, Roxana S. *7128* (1); *6953, 8012, 9140* (6); *909, 1347, 7283, 7702* (10); *3741, 7857, 7955* (11).
Ferris, R. S., & R. Bacigalupi. *8128* (6); *8502* (6).
Ferris, R. S., & R. Duthie. *4* (11).
Ferris, R. S., F. M. Scott, & R. Bacigalupi. *4036* (5); *3874* (10).
Fisher, George L. *37* (6); — (7).
Fosberg, F. R. *S3474,* — (1); *7951, 8381* (6); *S3960* (7); *8500* (11).

Fulton, H. J., see—R. H. Peebles.
Funston, F., see—F. V. Coville.
Gaines, G. W. — (1).
Gallegos, J. M. *1355* (6).
Galway, D. H. — (3).
Gander, Frank F. *2955, 3028, 13454* (6); *138.12, 1275* (9).
Garrett, A. O., see—P. A. Rydberg.
Gillespie, D. K. *9347* (11); see—I. L. Wiggins.
Gillespie, J. W. *5529* (9).
Gilman, M. F., see—F. V. Coville.
Godwin, A. — (3).
Goldman, E. A. *1127, 1196* (6); *2075, 2210* (11); see—E. W. Nelson.
Goodding, Leslie N. *2268* (1); *677a, 2234a* (3).
Goodman, George Jones. *2230, 2234a* (3).
Goodman, G. J., & F. A. Barkley. — (13).
Goodwin, R. — (3).
Goulding, J. M. — (11).
Graham, Edward H. *6123, 6171, 8840, 8933* (3); *8813, 9073, 9147, 9521* (11).
Grant, George B. — (3); *5644* (11).
Greene, Edward L. — (1).
Greenman, Jesse More, Jr. & Milton Turner. *74* (1).
Gregg, Josiah. *53* in part, *414* (7); *53* in part (14); *484* (15).
Griffiths, David. *3534* (1).
Grinnell, Fordyce. *436* (10a).
Haley, G. — (11).
Hall, D.— (3); — (11).
Hall, H. M. *5979* (6); *6212* (10); *527* (11).
Hanson, Herbert C. *A166* (3); *344* (13).
Harbison, C. F. *14851* (6).
Harris, J. Arthur. *M27134, C27713* (11).
Harrison, B. F. *301, 7398* (3); *6305, 6306* (10); *6382S, 8328, 8329* (11); *5913, 5914* (12a); see—W. D. Stanton.
Harrison, J. G., & T. H. Kearney. *7586* (9).
Hart, Cecil. — (6); — (10); *81* — (11).
Hartman, C. V. *642* (1).
Harvey, Mrs. D. R. *535* (6); *588* (7).
Harwood, R. D., see—P. A. Munz.
Hay, R., see—J. N. Rose.
Headley, F. B. *13* (11).
Heller, A. Arthur. *7743* (6); *7703* (10); *8299, 10411* (11).
Heller, A. A., & E. Gertrude. *3623* (3).
Henderson, L. F. *8670* (10).
Hermann, F. J. *4920* (11).
Herre, A. C. — (6).
Hillmann, P. H. — (11).
Hinckley, L. C. *257* (1).
Hitchcock, Albert S. *513 1/2* (11).
Hitchcock, C. Leo. *12329* (5); see—P. A. Munz.
Hough, W., see—J. W. Rose.
Hough, Mrs. W. — (3).
Howell, John Thomas. *3643* (5); *3247, 3409* (6); *2498, 2529* (10); *3824, 3924, 5028* (11); see—A. Eastwood.
Jaeger, E. C. *1061* (11).
Jepson, Willis L. *4784* (6); *4831* (10).
Jermy, C. *154* (13).
Johnston, Ivan M. *3020* (6); *3757* (7); — (9); — (10); *1721*, — (11); see—P. A. Munz; see—R. H. Peebles.
Jones, Marcus E. *3717, 25965, 25966, 26400, 26401, 26402, 26403*, — (1); *5029af, 5029ag, 5077az, 5110aq, 5468, 25962, 25964m*, — (3); — (5); *3076*, — (6); *3726, 25963, 28372*, — (7); — (8); *5062, 29008*, — (9); *1802* in part, *5388ag*, — (10); *1802* in part, *5001k, 5089r, 5124, 5213d, 5289y, 5297v, 5663bf, 6063c*, — (11); *5476v*, — (12a); *28371, 29009*, — (13).
Jones, W. W. *434* (1).
Kammerer, Alfred L. *5* (3).
Kearney, T. H., see—J. G. Harrison.
Kearney, T. H., & R. H. Peebles, *7748, 7759, 10897* (8); *11107* (11).

Keck, David D. *1833, 2248* (6); see—P. A. Munz.
Kellogg, N. B. — (3).
Kendall, L. — (11).
Kennedy, P. B. — (3); *1841* (9); *999, 1988* (10).
Kimber, G. C. — (11).
Kirkwood, J. E. *24* (7).
Kirkwood, J. E., & F. E. Lloyd. *86* (7).
Kline, E. — (1).
Lamb, F. H., see—W. R. Dudley.
Langford, M., see—R. A. Studhalter.
Layton, D. V. — (1).
Ledman, O. S., see—J. H. Ellis.
Lemmon, J. G. *252, 287,* — (7); *251,* — (10).
Lindheimer, Ferdinand. *414* in part (15).
Lloyd, F. E. — (1); *75, 214* (15); see—J. E. Kirkwood.
Long, H. C. — (12a).
Lumholtz, Carl. *24* (1).
Lundell, C. L. *5165* (14).
Macbride, Thomas H. — (10).
McCalla, W. C. — (6).
MacDougall, Douglas T. *100* (11).
MacFadden, F. A. *14476* (1); *14475* (6).
McGregor, E. A. *138* (6); see—L. R. Abrams.
McKelvey, Susan Delano. *1997, 1998* (1); *2287, 2288* (3); *2253* (7); *2285* (11); *2284* (12a); *1895* (13).
McMinn, H. E. *1431* (6).
Maguire, Bassett, & R. J. Becraft. *2479* (10).
Maguire, B., & H. L. Blood. *1277* (11).
Maguire, B., R. & G. B. *4715, 4722* (3); *4723, 4717, 4719* (10).
Maguire, B., & J. D. Redd. *1631* (12a).
Marcelline, Sister M. *1840* (3).
Marsh, Ernest G. *143, 694* (1); *64, 103* (7).
Mason, H. L. *2058, 2059* (6); *1976, 1977, 2021, 2021a* (7).
Mathias, Mildred E. *613, 614* (3); *611, 612, 645* (12a).
Mearns, Edgar A. *417, 2826, 2937* (1); *3024, 3332, 3864, 3923* (6); *2956* (7).
Mearns, E. A., & L. Schoenfeldt. *2916* (1); *3260* (6); *3079* (7).
Meiere, Mrs. Ernest. — (11).
Metcalfe, O. B. *811* (1).
Miers, S. M. — (1).
Monnet, P. *1110* (1); *839* (11).
Moore, John Adam, & Julian A. Steyermark. *3083, 3287* (1); *3258* (7).
Mueller, C. H. *7951* (7); see—F. L. Wynd.
Mulford, A. Isabel. *187, 187a, 1025* (1); *272* (7).
Munz, Philip A. *1408, 7823* (1); *4548, 8026, 9567, 9570, 13805* (6); *14983* (8); *12955* (9); *12468* (10); *6876, 6979, 8188, 11082* (11).
Munz, P. A., & C. L. Hitchcock. *12072, 12073* (6); *12047* (9).
Munz, P. A., & I. M. Johnston. *5286* (6).
Munz, P. A., I. M. Johnston & R. D. Harwood. *4029* (7).
Munz, P. A., & D. D. Keck. *4789* (9); *4951* (11).
Nealley, T. C. *258* (15).
Nelson, Aven. *10286* (8); *11280a* (9); *9990* (11).
Nelson, A. & R. *1259, 1290, 1619* (1); *2136* (3); *1716* (8); *2087* (12a).
Nelson, E. W. *6014* (1); *4472* (7).
Nelson, W. W., & E. A. Goldman. *7548* (6).
Noldke, A. M. — (11).
Nuttall, T. W. — (1).
Nutter-Cox, F. — (6).
Orcutt, C. R. *1271,* — (6).
Ownbey, Francis Marion & Ruth Peck. *1633, 1647* (1).
Painter, J. H., see—J. N. Rose.
Palmer, Edward. *68, 172, 523 1/2,* — (1); *364, 365* (6); *69, 695, 1288* (7); *524* (10); *525* (11); *854, 1289* in part, *1292* (13); *149, 283, 372, 702, 1289* in part, *1290, 1291, 1292* — (15); see—E. Coues; see—C. C. Parry.

Palmer, Ernest J. *30989* (1); *13873, 14155* (3); *33475, 34145* (7); *12491* (12); *10190, 10309, 10951, 11238, 13028, 26783* (13).
Parish, S. B. *8222* (1); *9070* (9); *2974, 11841* (10); *207* (11).
Parish, S. B. & W. F. *745, 753* (1); *653, 1153* (6); — (7); *1238* (8); *1368, 1369* (10).
Parish, W. F. — (1).
Parks, H. B. *12175, 12176, 12177* (13a).
Parks, H. B., & V. L. Cory. *11707* (12).
Parry, C. C. — (1); *250,* — (3); — (6); *249, 251* in part (9); *251* in part (11); — (15).
Parry, C. C., & E. Palmer *854* (13); *855* (15).
Payson, Edwin B. *108, 319, 353* (3); *367, 1199* (12a).
Payson, E. & Lois B. *3833* (3).
Pearson, G. A. *225* (11).
Peebles, R. H. *9352* (12a); see—T. H. Kearney.
Peebles, R. H. & H. J. Fulton. *11874, 11940* (3); *11857, 11935* (12a).
Peebles, R. H., & E. G. Smith. *13340, 13361* (12a).
Peirson, F. W. *7193* (1).
Peirson, F. W., & I. M. Johnston. *6510* (11).
Phares, J. F. — (11).
Pond, Charles F. — (7).
Pringle, Cyrus Guernsey, *88, 868, 1589,* — (1); — (6); *38, 39,* — (7); — (10); *134* (15).
Purer, Edith A. *7127* (6).
Purpus, C. A. *6, 269, 1102, 5334* (7); *5032* (10); *5312, 7087* (11); *3054, 5698* (14).
Redd, J. D., see—B. Maguire.
Reed, E. L. *3718, 3719, 3735, 3897, 4103, 4200, 4354* — (12); *3628, 3946, 4113, 4143* (13).
Reed, Fred M. *6215, 6320* (6).
Rehn, J. A. G., & H. L. Viereck. — (1).
Reverchon, J. *925* (13); *1658,* — (15).
Reynolds, Mrs. J. C. — (1).
Robison, William, see—C. C. Epling.
Rodda, Mrs. A. F. — (11).
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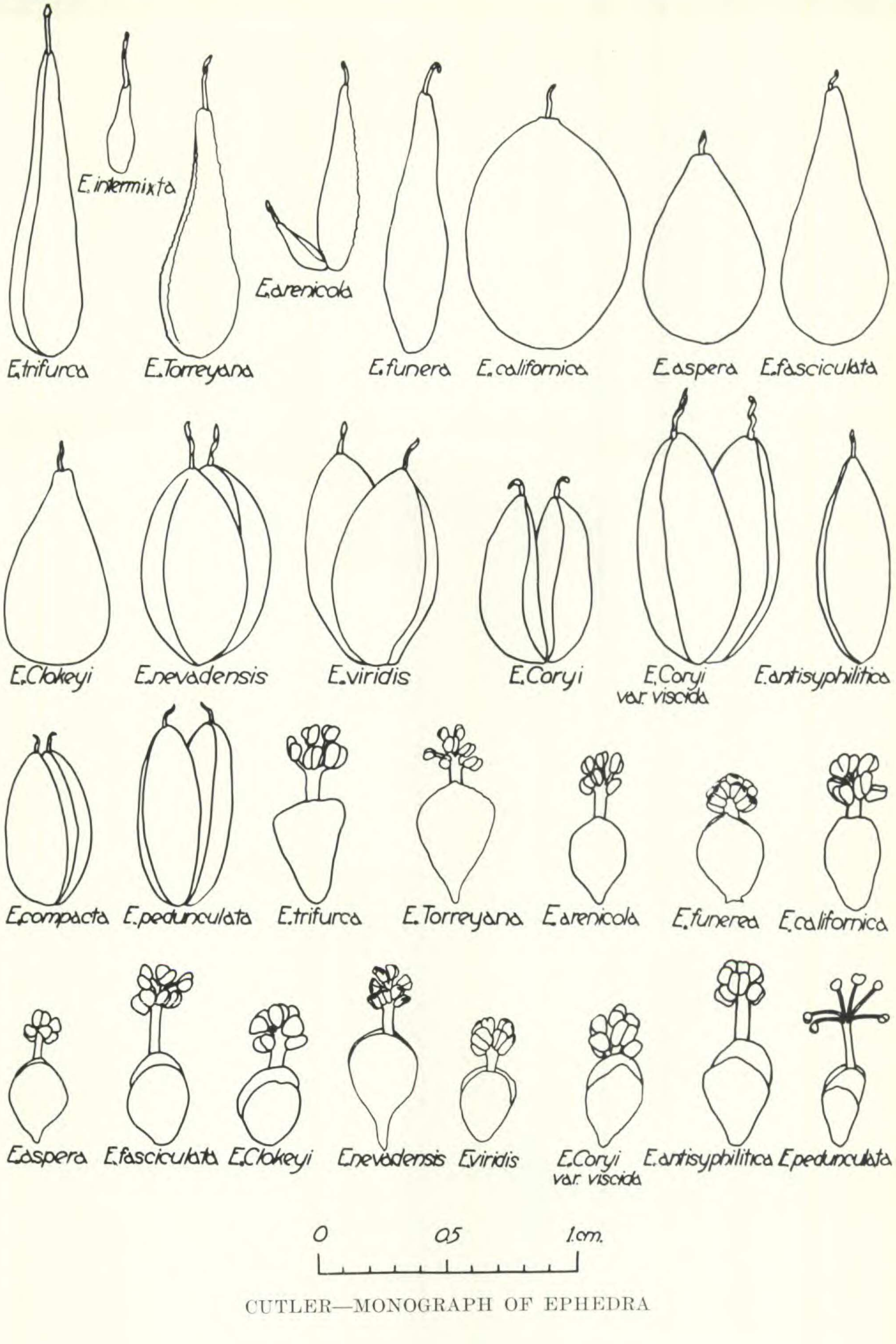
Explanation of Plate

PLATE 27

Typical seeds with tubilli; typical staminate bracts with included perianths and antherophores.



CUTLER—MONOGRAPH OF EPHEDRA

EXPLANATION OF PLATE

PLATE 28

Geographical distribution of species of *Ephedra.*

Fig. 1. *E. trifurca* ——————
E. intermixta ●
E. Torreyana — — — — — —
E. arenicola ×
E. funerea ——————*
E. californica —||—||—||—
Fig. 2. *E. aspera* ——————
E. fasciculata ....
E. Clokeyi — — — — — —
Fig. 3. *E. nevadensis* — — — — — —*
E. viridis ——————
E. Coryi —×—×—×—
E. Coryi var. *viscida* —||—||—||—
Fig. 4. *E. antisyphilitica* ——————
E. compacta —||—||—||—
E. pedunculata — — — — — —

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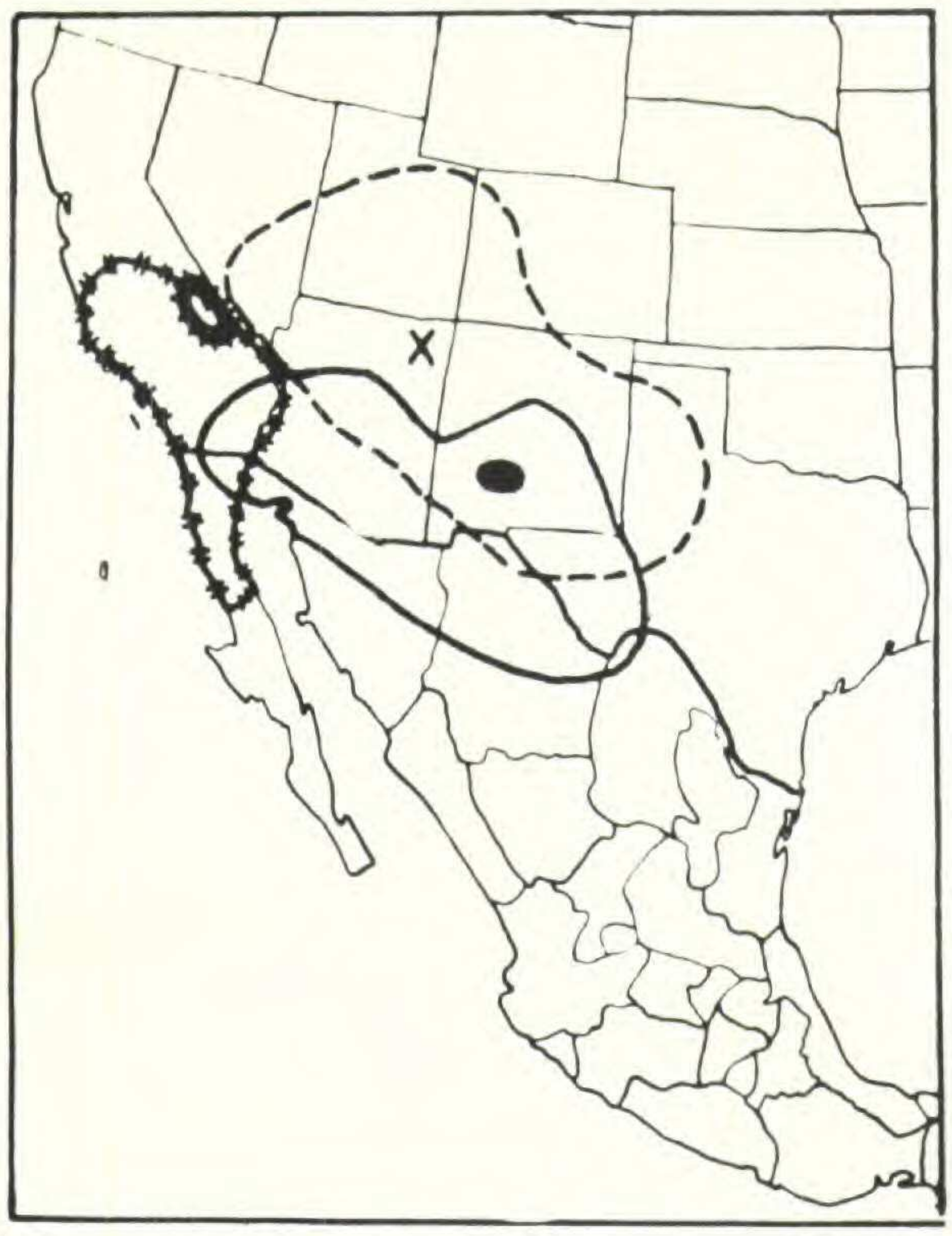
* NOTE: Since the maps were made *E. funerea* has been collected in southeastern Nevada (Clark Co.), and *E. nevadensis,* in Harney Co., Oregon.



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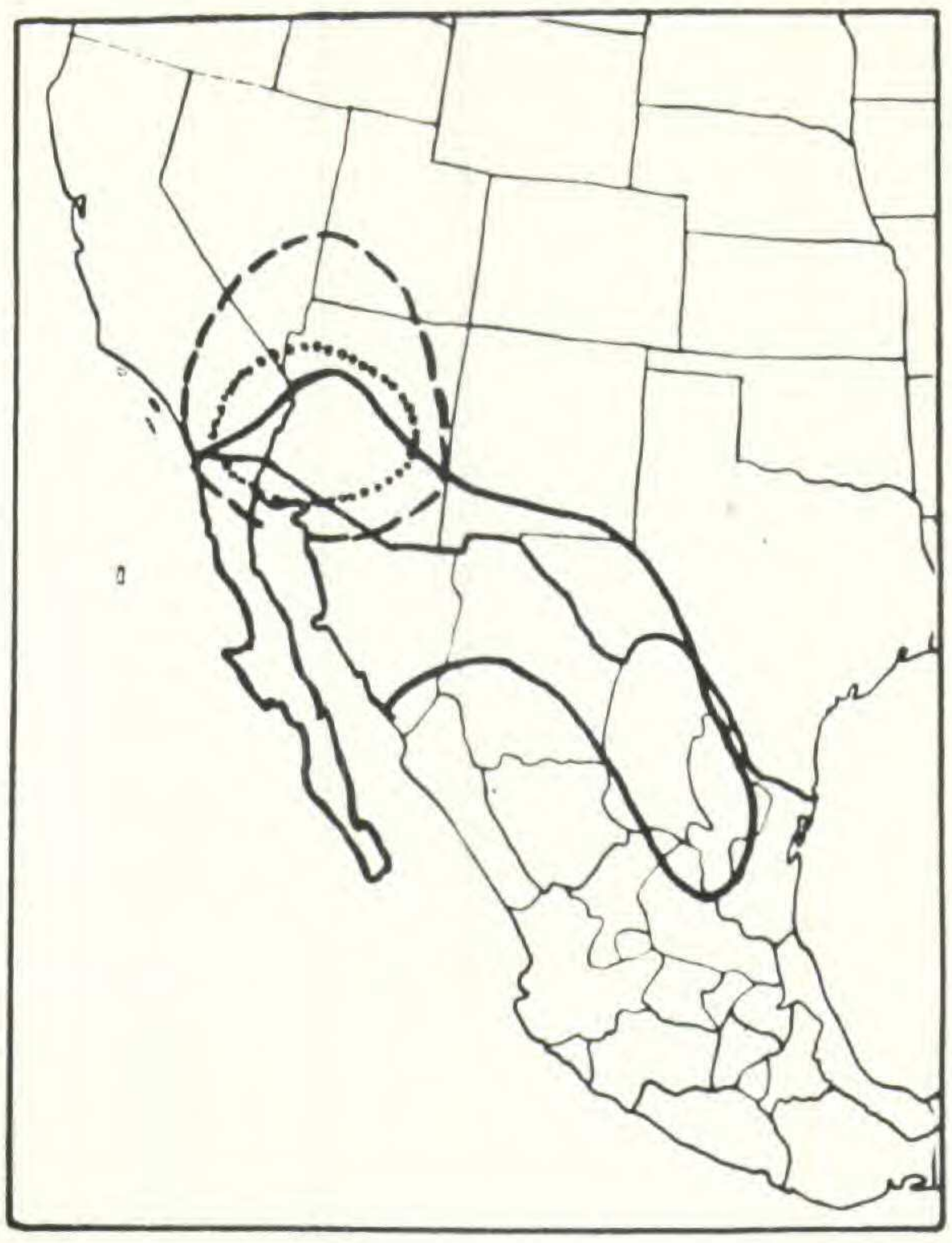

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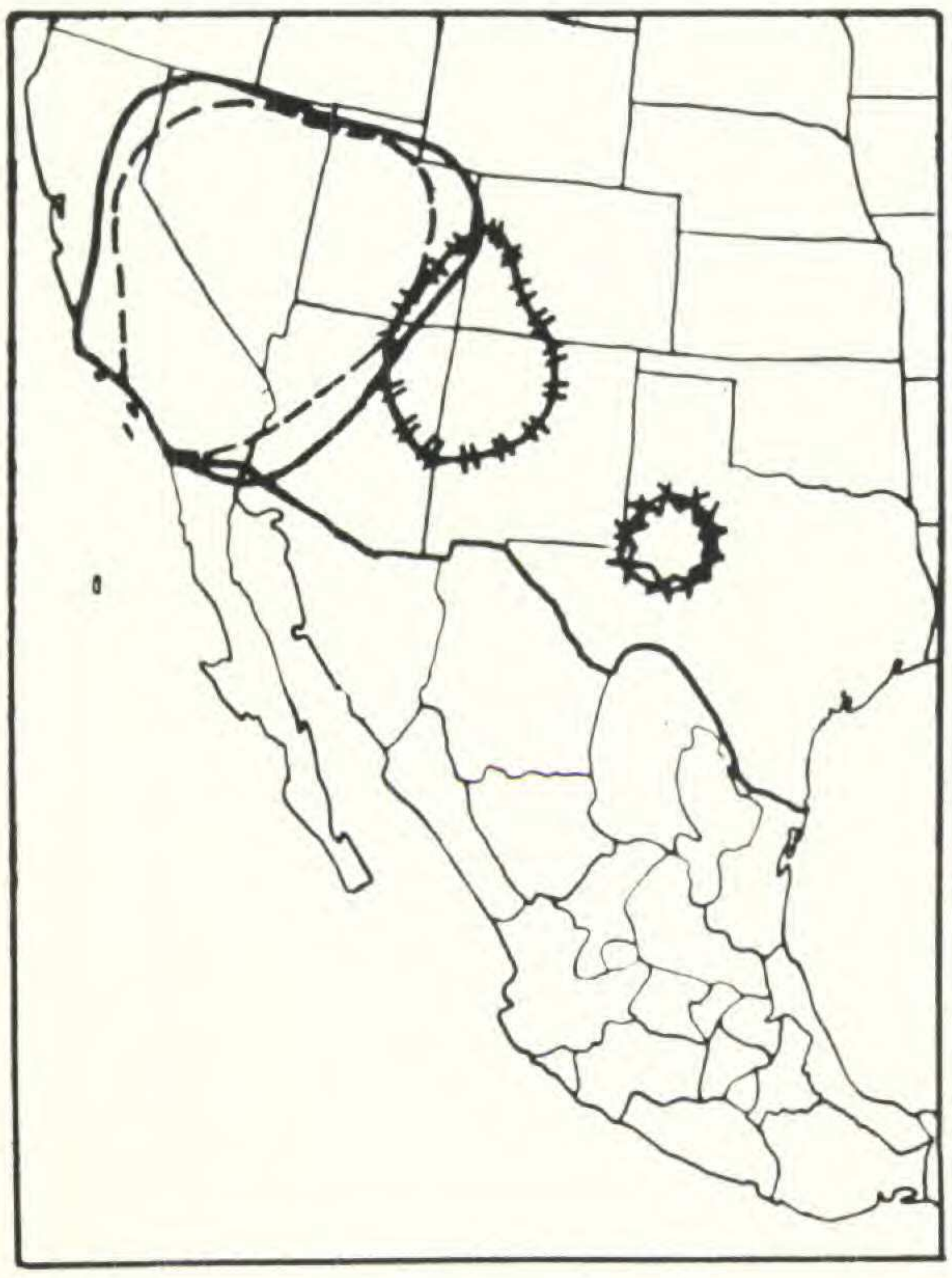

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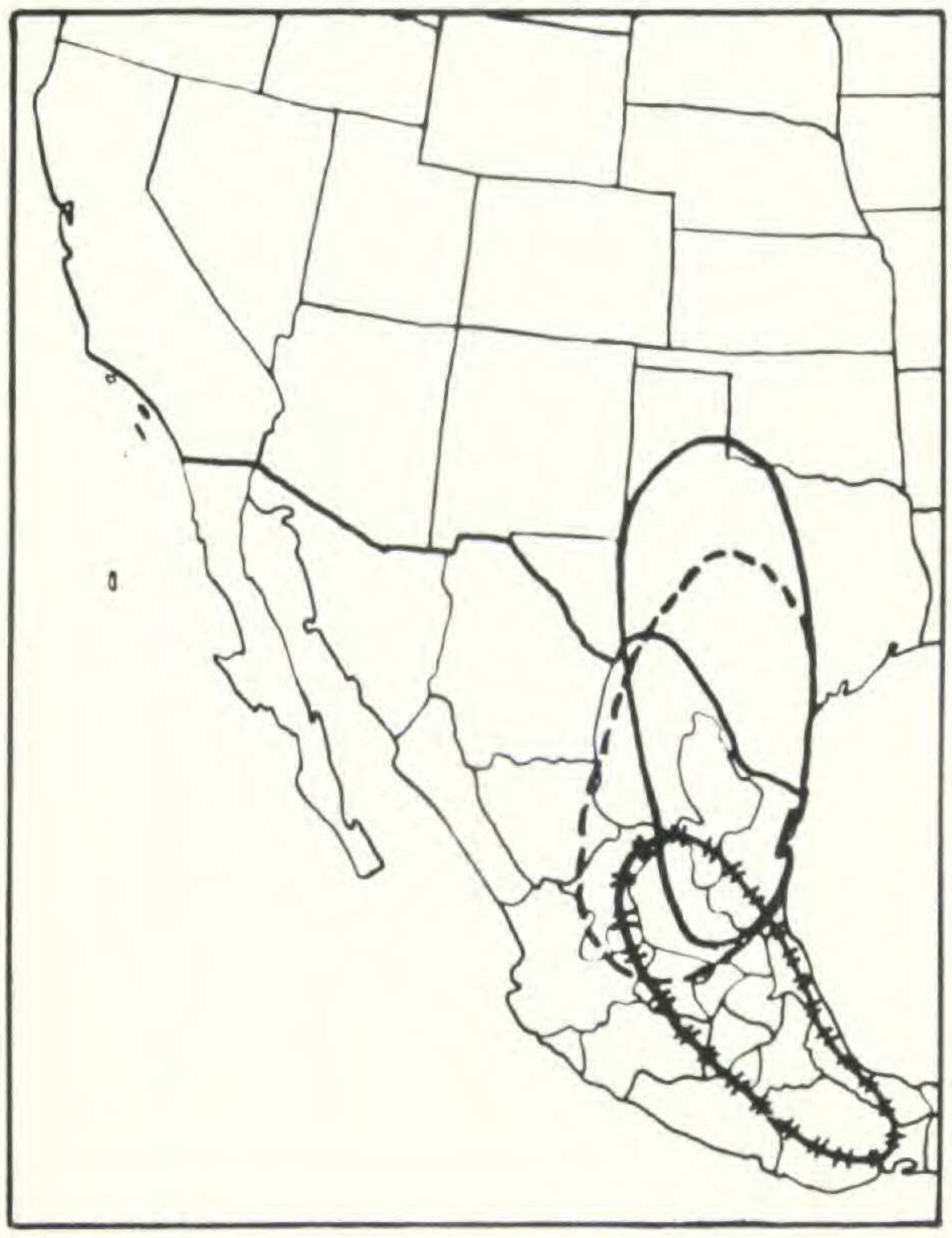

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CUTLER—MONOGRAPH OF EPHEDRA